iAP20 Rec'd PCT/PTO 20 JUL 2005

SEQUENCE LISTING

<110> AKZO Nobel N.V.

<120> *Lawsonia intracellularis* subunit vaccines.

<130> 2004.001

<160> 18

<170> PatentIn version 3.2

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Gly Leu Leu Ser His Gly Glu Lys Met Asn Val Ile Gly Asn Asn Ile
        15   20   25

gct aac gta aat aca gta ggc ttt aaa ggc caa cgt atg gat ttc gca   147
Ala Asn Val Asn Thr Val Gly Phe Lys Gly Gln Arg Met Asp Phe Ala
        30   35   40

gac ttt att tat caa gat ggc ttt agt act gca ggg att aca caa att   195
Asp Phe Ile Tyr Gln Asp Gly Phe Ser Thr Ala Gly Ile Thr Gln Ile
45   50   55   60

gga cgt ggt gta ggc att gga gct gtc atg ggg aac ttt ggt cag ggt   243
Gly Arg Gly Val Gly Ile Gly Ala Val Met Gly Asn Phe Gly Gln Gly
                65   70   75

agt ttt gaa acc aca act gaa gca aca gac ctt gct att ggt ggt cgt   291
Ser Phe Glu Thr Thr Thr Glu Ala Thr Asp Leu Ala Ile Gly Gly Arg
                80   85   90

gga ttt ttc aaa gtt aaa cca caa gga tca gag act tca tat tat acc   339
Gly Phe Phe Lys Val Lys Pro Gln Gly Ser Glu Thr Ser Tyr Tyr Thr
        95   100   105

cgt gca ggt aat ttt cgt ttt aat aat gat gga tac tta gtt gat cct   387
Arg Ala Gly Asn Phe Arg Phe Asn Asn Asp Gly Tyr Leu Val Asp Pro
        110   115   120

cat gga tat gct ctt cag ggt tgg aaa att gat aat act gaa ggg cca   435
His Gly Tyr Ala Leu Gln Gly Trp Lys Ile Asp Asn Thr Glu Gly Pro
125   130   135   140

caa cgt atc tca ggt ggt gtt aat cca ggt aca aat act tcg cag att   483

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        Gln Arg Ile Ser Gly Gly Val Asn Pro Gly Thr Asn Thr Ser Gln Ile
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        atg ggt aca ggt gaa cca aca gat atc cgt ctt gat act tgg aca gtt      531
        Met Gly Thr Gly Glu Pro Thr Asp Ile Arg Leu Asp Thr Trp Thr Val
                    160             165             170

        gca cct tta cag aca aca aat gta agt ttt aac gta aac ctt tct tct      579
        Ala Pro Leu Gln Thr Thr Asn Val Ser Phe Asn Val Asn Leu Ser Ser
                    175             180             185

        gat aaa tct gga gat aaa tct caa aac gtt aat agt cca ttt acc tca      627
        Asp Lys Ser Gly Asp Lys Ser Gln Asn Val Asn Ser Pro Phe Thr Ser
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        tta ttt aat ata tgg aat ggt aaa caa cca agt gaa cct aac aat cca      675
        Leu Phe Asn Ile Trp Asn Gly Lys Gln Pro Ser Glu Pro Asn Asn Pro
        205             210             215             220

        cct atg cct gaa agt gca tat agt tat cag aca tct att aag gta tat      723
        Pro Met Pro Glu Ser Ala Tyr Ser Tyr Gln Thr Ser Ile Lys Val Tyr
                    225             230             235

        gat gaa gct ggt gga aca cat aca tta aca gtc tat ttt gac caa gtt      771
        Asp Glu Ala Gly Gly Thr His Thr Leu Thr Val Tyr Phe Asp Gln Val
                    240             245             250

        tct cct aaa gac tac aaa ggt ggt gga agt gga gaa agt gta tgg gaa      819
        Ser Pro Lys Asp Tyr Lys Gly Gly Gly Ser Gly Glu Ser Val Trp Glu
                255             260             265

        tac gtt gtt act atg gat cct tct gaa gat aat cgc caa gtt tct gtt      867
        Tyr Val Val Thr Met Asp Pro Ser Glu Asp Asn Arg Gln Val Ser Val
                270             275             280

        ggt ggt aac att gtg gac atc aaa gat act aaa gct gca gga atg tta      915
        Gly Gly Asn Ile Val Asp Ile Lys Asp Thr Lys Ala Ala Gly Met Leu
        285             290             295             300

        atg tca gga aca ttg agt ttt gat agc tca gga aaa ctt gca aac caa      963
        Met Ser Gly Thr Leu Ser Phe Asp Ser Ser Gly Lys Leu Ala Asn Gln
                    305             310             315

        agt gca tat tcg ctg aat ggt tca cgt aag cct gca gtt gat cct gca     1011
        Ser Ala Tyr Ser Leu Asn Gly Ser Arg Lys Pro Ala Val Asp Pro Ala
                    320             325             330

        acc gga gct ctt att aat ggt aat ggt ttt act att gat aga gat gga     1059
        Thr Gly Ala Leu Ile Asn Gly Asn Gly Phe Thr Ile Asp Arg Asp Gly
                    335             340             345

        aat gca att cct att ctt aat ata gat aat cca gct gaa aac ttc tat     1107
        Asn Ala Ile Pro Ile Leu Asn Ile Asp Asn Pro Ala Glu Asn Phe Tyr
                350             355             360

        cca gca gaa gtt tct aat aat gga ttt cct atg att gta gct aat ttt     1155
        Pro Ala Glu Val Ser Asn Asn Gly Phe Pro Met Ile Val Ala Asn Phe
        365             370             375             380

        act ggt gtc cca ggt aaa aat aca gct gga tct gtt ggt gat gct acc     1203
        Thr Gly Val Pro Gly Lys Asn Thr Ala Gly Ser Val Gly Asp Ala Thr
                    385             390             395

        acc ttt ttt aca gaa att gac ttt ggt tta aaa gct act gat ctt gat     1251
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                    400                    405                    410
aat aca tgg aag aat gca aat gaa cct ctt tct tct tta agc tat aaa      1299
Asn Thr Trp Lys Asn Ala Asn Glu Pro Leu Ser Ser Leu Ser Tyr Lys
        415             420                 425

aaa aca cat aat cct atg gat gtc gca ggt ggt tgg aca gtt ggt ggg      1347
Lys Thr His Asn Pro Met Asp Val Ala Gly Gly Trp Thr Val Gly Gly
        430             435                 440

tat aaa act cca gct cca tca gta act gaa ctt ggt atg gct cag ata      1395
Tyr Lys Thr Pro Ala Pro Ser Val Thr Glu Leu Gly Met Ala Gln Ile
445             450                 455                     460

ttg gaa aat cct gct ggg gta atg cca caa tat tat ttt ggt aac cct      1443
Leu Glu Asn Pro Ala Gly Val Met Pro Gln Tyr Tyr Phe Gly Asn Pro
                465                 470                 475

aac tat gat aac aca gtt cca cag agt cca cca tat gta tat aaa aat      1491
Asn Tyr Asp Asn Thr Val Pro Gln Ser Pro Pro Tyr Val Tyr Lys Asn
            480                 485                 490

gaa gct tct tat cag gct gca tat aag act gca tta act gcc gca ggt      1539
Glu Ala Ser Tyr Gln Ala Ala Tyr Lys Thr Ala Leu Thr Ala Ala Gly
        495                 500                 505

ggt acc gca gct gac att aaa aag gaa cat tgg cct cat aat gct gca      1587
Gly Thr Ala Ala Asp Ile Lys Lys Glu His Trp Pro His Asn Ala Ala
        510             515                 520

tca ggt ata tta gaa gct aat gat cca cca aat gtt aaa gac tta gct      1635
Ser Gly Ile Leu Glu Ala Asn Asp Pro Pro Asn Val Lys Asp Leu Ala
525             530                 535                     540

aat atg aat gga aca cca aac cgc tta tca aat gcg ttt act aac tat      1683
Asn Met Asn Gly Thr Pro Asn Arg Leu Ser Asn Ala Phe Thr Asn Tyr
                545                 550                 555

gca ggt ggt agc tct aca aaa tct gca agt caa aat ggt tat ggt ttt      1731
Ala Gly Gly Ser Ser Thr Lys Ser Ala Ser Gln Asn Gly Tyr Gly Phe
                560                 565                 570

ggt gat tta atg aac tat agt gta aat gct gag gga gtg tta ttt gga      1779
Gly Asp Leu Met Asn Tyr Ser Val Asn Ala Glu Gly Val Leu Phe Gly
            575                 580                 585

gta tat tca aat gga gta caa ctt cca tta tat caa gta gct ctt tat      1827
Val Tyr Ser Asn Gly Val Gln Leu Pro Leu Tyr Gln Val Ala Leu Tyr
        590                 595                 600

gat ttt aac tct aaa cag ggg tta cgt cgt gaa ggt ggt aac tta ttt      1875
Asp Phe Asn Ser Lys Gln Gly Leu Arg Arg Glu Gly Gly Asn Leu Phe
605             610                 615                     620

agt caa aca aga gaa tca ggg gac cca tct tca ggt gct gca aac act      1923
Ser Gln Thr Arg Glu Ser Gly Asp Pro Ser Ser Gly Ala Ala Asn Thr
                625                 630                 635

tct ggg ttt ggt tca att aac gct aat act tta gaa gga tca aac gta      1971
Ser Gly Phe Gly Ser Ile Asn Ala Asn Thr Leu Glu Gly Ser Asn Val
                640                 645                 650

gat ata tct aca gag ttt gtc tca atg att gca aca caa cgt gga ttc      2019
Asp Ile Ser Thr Glu Phe Val Ser Met Ile Ala Thr Gln Arg Gly Phe
            655                 660                 665
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cag tca aat agt aaa att gta act act att gac caa atg tta gag aca        2067
Gln Ser Asn Ser Lys Ile Val Thr Thr Ile Asp Gln Met Leu Glu Thr
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685             690
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Thr Val Gly Phe Lys Gly Gln Arg Met Asp Phe Ala Asp Phe Ile Tyr
        35              40              45


Gln Asp Gly Phe Ser Thr Ala Gly Ile Thr Gln Ile Gly Arg Gly Val
    50              55              60


Gly Ile Gly Ala Val Met Gly Asn Phe Gly Gln Gly Ser Phe Glu Thr
65              70              75              80


Thr Thr Glu Ala Thr Asp Leu Ala Ile Gly Gly Arg Gly Phe Phe Lys
            85              90              95


Val Lys Pro Gln Gly Ser Glu Thr Ser Tyr Tyr Thr Arg Ala Gly Asn
        100             105             110


Phe Arg Phe Asn Asn Asp Gly Tyr Leu Val Asp Pro His Gly Tyr Ala
        115             120             125


Leu Gln Gly Trp Lys Ile Asp Asn Thr Glu Gly Pro Gln Arg Ile Ser
    130             135             140


Gly Gly Val Asn Pro Gly Thr Asn Thr Ser Gln Ile Met Gly Thr Gly
145             150             155             160


Glu Pro Thr Asp Ile Arg Leu Asp Thr Trp Thr Val Ala Pro Leu Gln
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Thr Thr Asn Val Ser Phe Asn Val Asn Leu Ser Ser Asp Lys Ser Gly
        180             185             190
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Asp Lys Ser Gln Asn Val Asn Ser Pro Phe Thr Ser Leu Phe Asn Ile
    195                 200             205


Trp Asn Gly Lys Gln Pro Ser Glu Pro Asn Asn Pro Pro Met Pro Glu
    210                 215             220


Ser Ala Tyr Ser Tyr Gln Thr Ser Ile Lys Val Tyr Asp Glu Ala Gly
225                 230             235                 240


Gly Thr His Thr Leu Thr Val Tyr Phe Asp Gln Val Ser Pro Lys Asp
            245             250             255


Tyr Lys Gly Gly Gly Ser Gly Glu Ser Val Trp Glu Tyr Val Val Thr
            260             265             270


Met Asp Pro Ser Glu Asp Asn Arg Gln Val Ser Val Gly Gly Asn Ile
    275             280             285


Val Asp Ile Lys Asp Thr Lys Ala Ala Gly Met Leu Met Ser Gly Thr
    290             295             300


Leu Ser Phe Asp Ser Ser Gly Lys Leu Ala Asn Gln Ser Ala Tyr Ser
305             310             315             320


Leu Asn Gly Ser Arg Lys Pro Ala Val Asp Pro Ala Thr Gly Ala Leu
            325             330             335


Ile Asn Gly Asn Gly Phe Thr Ile Asp Arg Asp Gly Asn Ala Ile Pro
            340             345             350


Ile Leu Asn Ile Asp Asn Pro Ala Glu Asn Phe Tyr Pro Ala Glu Val
    355             360             365


Ser Asn Asn Gly Phe Pro Met Ile Val Ala Asn Phe Thr Gly Val Pro
    370             375             380


Gly Lys Asn Thr Ala Gly Ser Val Gly Asp Ala Thr Thr Phe Phe Thr
385             390             395             400


Glu Ile Asp Phe Gly Leu Lys Ala Thr Asp Leu Asp Asn Thr Trp Lys
            405             410             415


Asn Ala Asn Glu Pro Leu Ser Ser Leu Ser Tyr Lys Lys Thr His Asn
            420             425             430


Pro Met Asp Val Ala Gly Gly Trp Thr Val Gly Gly Tyr Lys Thr Pro
        435             440             445


Ala Pro Ser Val Thr Glu Leu Gly Met Ala Gln Ile Leu Glu Asn Pro
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              450                    455                    460


      Ala Gly Val Met Pro Gln Tyr Tyr Phe Gly Asn Pro Asn Tyr Asp Asn
      465                 470             475                 480


      Thr Val Pro Gln Ser Pro Pro Tyr Val Tyr Lys Asn Glu Ala Ser Tyr
                      485             490                 495


      Gln Ala Ala Tyr Lys Thr Ala Leu Thr Ala Ala Gly Gly Thr Ala Ala
                  500             505                 510


      Asp Ile Lys Lys Glu His Trp Pro His Asn Ala Ala Ser Gly Ile Leu
                  515             520                 525


      Glu Ala Asn Asp Pro Pro Asn Val Lys Asp Leu Ala Asn Met Asn Gly
              530             535                 540


      Thr Pro Asn Arg Leu Ser Asn Ala Phe Thr Asn Tyr Ala Gly Gly Ser
      545                 550             555                 560


      Ser Thr Lys Ser Ala Ser Gln Asn Gly Tyr Gly Phe Gly Asp Leu Met
                  565                 570                 575


      Asn Tyr Ser Val Asn Ala Glu Gly Val Leu Phe Gly Val Tyr Ser Asn
                  580             585                 590


      Gly Val Gln Leu Pro Leu Tyr Gln Val Ala Leu Tyr Asp Phe Asn Ser
                  595             600                 605


      Lys Gln Gly Leu Arg Arg Glu Gly Gly Asn Leu Phe Ser Gln Thr Arg
          610             615                 620


      Glu Ser Gly Asp Pro Ser Ser Gly Ala Ala Asn Thr Ser Gly Phe Gly
      625             63 0                635                 640


      Ser Ile Asn Ala Asn Thr Leu Glu Gly Ser Asn Val Asp Ile Ser Thr
                      645             650                 655


      Glu Phe Val Ser Met Ile Ala Thr Gln Arg Gly Phe Gln Ser Asn Ser
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                                   1           5


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Phe Thr Val Gly Ile Ile Met Leu Ile Leu Ala Cys Leu Ala Ala Leu
         10              15              20


gag ttc ata caa gat ttt ccc aat agc tat caa gaa gat gga caa atg         148
Glu Phe Ile Gln Asp Phe Pro Asn Ser Tyr Gln Glu Asp Gly Gln Met
     25              30              35


gtt aca gga att att tca aaa ata ata ggc tct aac tgt gat aat tct         196
Val Thr Gly Ile Ile Ser Lys Ile Ile Gly Ser Asn Cys Asp Asn Ser
40              45              50              55


tca aca tct gat ata aat aat aag aaa tcc ata gat aga gat aaa gat         244
Ser Thr Ser Asp Ile Asn Asn Lys Lys Ser Ile Asp Arg Asp Lys Asp
                 60              65              70


aca tta ctc tca agt agt aat aga aat aca ata caa gcc ggt act cca         292
Thr Leu Leu Ser Ser Ser Asn Arg Asn Thr Ile Gln Ala Gly Thr Pro
             75              80              85


cat caa gaa aat aac ata aaa gaa gat ctt caa ctg act aac aaa aat         340
His Gln Glu Asn Asn Ile Lys Glu Asp Leu Gln Leu Thr Asn Lys Asn
             90              95              100


gaa caa aca act cca gaa gaa gaa gaa gaa agt aaa ttt att tgg tta         388
Glu Gln Thr Thr Pro Glu Glu Glu Glu Glu Ser Lys Phe Ile Trp Leu
     105             110             115


aca gaa gct cca tca gag ctt aaa aaa gga gaa aaa gct ata aca caa         436
Thr Glu Ala Pro Ser Glu Leu Lys Lys Gly Glu Lys Ala Ile Thr Gln
120             125             130             135


aca aga ttg tct att ggt aag gat ata tct ttt aga att act gct gat         484
Thr Arg Leu Ser Ile Gly Lys Asp Ile Ser Phe Arg Ile Thr Ala Asp
                 140             145             150


gat gcc atc aaa gct caa tca atg atg tta aaa aat cca gat agg ttt         532
Asp Ala Ile Lys Ala Gln Ser Met Met Leu Lys Asn Pro Asp Arg Phe
             155             160             165


gtt tta gat ctt caa gga aag tgg ggt att tcc ctt cca cct att cca         580
Val Leu Asp Leu Gln Gly Lys Trp Gly Ile Ser Leu Pro Pro Ile Pro
         170             175             180


cct aca aat cct tgg tta aaa aaa ata cgc tta ggt act aat aat gga         628
Pro Thr Asn Pro Trp Leu Lys Lys Ile Arg Leu Gly Thr Asn Asn Gly
         185             190             195


aat aca cga ctt gtc ttt gat ctt caa aaa aaa cca tct aaa act gaa         676
Asn Thr Arg Leu Val Phe Asp Leu Gln Lys Lys Pro Ser Lys Thr Glu
200             205             210             215
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att aaa caa tta gat aca aat aaa att gaa atc caa att cattaaattg          725
Ile Lys Gln Leu Asp Thr Asn Lys Ile Glu Ile Gln Ile
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            20                  25                  30


Tyr Gln Glu Asp Gly Gln Met Val Thr Gly Ile Ile Ser Lys Ile Ile
            35                  40                  45


Gly Ser Asn Cys Asp Asn Ser Ser Thr Ser Asp Ile Asn Asn Lys Lys
    50                  55                  60


Ser Ile Asp Arg Asp Lys Asp Thr Leu Leu Ser Ser Ser Asn Arg Asn
65                  70                  75                  80


Thr Ile Gln Ala Gly Thr Pro His Gln Glu Asn Asn Ile Lys Glu Asp
                85                  90                  95


Leu Gln Leu Thr Asn Lys Asn Glu Gln Thr Thr Pro Glu Glu Glu Glu
            100                 105                 110


Glu Ser Lys Phe Ile Trp Leu Thr Glu Ala Pro Ser Glu Leu Lys Lys
            115                 120                 125


Gly Glu Lys Ala Ile Thr Gln Thr Arg Leu Ser Ile Gly Lys Asp Ile
    130                 135                 140


Ser Phe Arg Ile Thr Ala Asp Asp Ala Ile Lys Ala Gln Ser Met Met
145                 150                 155                 160


Leu Lys Asn Pro Asp Arg Phe Val Leu Asp Leu Gln Gly Lys Trp Gly
                165                 170                 175


Ile Ser Leu Pro Pro Ile Pro Pro Thr Asn Pro Trp Leu Lys Lys Ile
            180                 185                 190


Arg Leu Gly Thr Asn Asn Gly Asn Thr Arg Leu Val Phe Asp Leu Gln
    195                 200                 205
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Lys Lys Pro Ser Lys Thr Glu Ile Lys Gln Leu Asp Thr Asn Lys Ile
    210                 215                 220


Glu Ile Gln Ile
225


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<222>   (34)..(1677)

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                                    Met His Gln Lys Ser Cys Leu
                                    1               5


gtt gct tta tgt att atg ttt att att atg gtg caa gtt ctt cag gca        102
Val Ala Leu Cys Ile Met Phe Ile Ile Met Val Gln Val Leu Gln Ala
        10              15              20


aat gca gct agc tat gtg gtt ttg cca ttt aaa gta aat gct cct cca        150
Asn Ala Ala Ser Tyr Val Val Leu Pro Phe Lys Val Asn Ala Pro Pro
    25              30              35


agc tat act tat ttg gaa aaa gct atc cca tct atg tta act tct aga        198
Ser Tyr Thr Tyr Leu Glu Lys Ala Ile Pro Ser Met Leu Thr Ser Arg
40              45              50              55


ctt tat tgg gaa gaa cgt ttt caa cct atc ccg gat gct aat gct att        246
Leu Tyr Trp Glu Glu Arg Phe Gln Pro Ile Pro Asp Ala Asn Ala Ile
                60              65              70


aaa gca gga aag gta gaa gat ata aag gaa atg gat aag gca agg ata        294
Lys Ala Gly Lys Val Glu Asp Ile Lys Glu Met Asp Lys Ala Arg Ile
            75              80              85


gct aca ggt gca gac tat ctt ata tgg gga cag gta aat att gta ggt        342
Ala Thr Gly Ala Asp Tyr Leu Ile Trp Gly Gln Val Asn Ile Val Gly
        90              95              100


gat gaa gct acg ctt gat gta caa gtt tgt gat ata gaa gga tca att        390
Asp Glu Ala Thr Leu Asp Val Gln Val Cys Asp Ile Glu Gly Ser Ile
        105             110             115


tgg agg aaa agt aaa aat aca aaa gtt gat aat tta att act gcc ctt        438
Trp Arg Lys Ser Lys Asn Thr Lys Val Asp Asn Leu Ile Thr Ala Leu
120             125             130             135


caa gat aca gca gat gca att aat agt gag ttg ttt ggg cgt gca act        486
Gln Asp Thr Ala Asp Ala Ile Asn Ser Glu Leu Phe Gly Arg Ala Thr
            140             145             150


aca aaa cca tca tca aaa gct act att gta gct caa atg aac tct gga        534
Thr Lys Pro Ser Ser Lys Ala Thr Ile Val Ala Gln Met Asn Ser Gly
            155             160             165


ttg att aag gga aaa gga aat gaa aat cag tca tat ctt aat cca gaa        582
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Leu Ile Lys Gly Lys Gly Asn Glu Asn Gln Ser Tyr Leu Asn Pro Glu
        170   175   180

ttt cgt tat caa gga agc aat ctt tcc cgt ggc cga agt caa gct ctt   630
Phe Arg Tyr Gln Gly Ser Asn Leu Ser Arg Gly Arg Ser Gln Ala Leu
        185   190   195

ccc ttt gct tca gtt ggt ata gtt gtt ggt gac ttt ata gga gat aat   678
Pro Phe Ala Ser Val Gly Ile Val Val Gly Asp Phe Ile Gly Asp Asn
200   205   210   215

aaa aat gaa gtt gcc ata tta agt gag tat aaa gtc cat att tat cga   726
Lys Asn Glu Val Ala Ile Leu Ser Glu Tyr Lys Val His Ile Tyr Arg
                220   225   230

tgg gaa gaa gaa agg tta gct ctt ctt gga gaa tat aaa ttc cct cgc   774
Trp Glu Glu Glu Arg Leu Ala Leu Leu Gly Glu Tyr Lys Phe Pro Arg
                235   240   245

tca cta cag tct tta cat att cgt gct ttt gat gtg gat cat gat ggt   822
Ser Leu Gln Ser Leu His Ile Arg Ala Phe Asp Val Asp His Asp Gly
        250   255   260

gta cag gaa atc att gtt tct tgc ttt gat cct tca tat gca aag cca   870
Val Gln Glu Ile Ile Val Ser Cys Phe Asp Pro Ser Tyr Ala Lys Pro
        265   270   275

tat tcg ttt att ctt agt ttt aaa aat aga gtg ttt aaa gag tta gcc   918
Tyr Ser Phe Ile Leu Ser Phe Lys Asn Arg Val Phe Lys Glu Leu Ala
280   285   290   295

aca aac tta cca ttt tat tta aat gtg gtt aaa ctt cca cca gat ttt   966
Thr Asn Leu Pro Phe Tyr Leu Asn Val Val Lys Leu Pro Pro Asp Phe
                300   305   310

tct cct atg tta att ggt caa aag agt gac aat tca agg att ttt tct   1014
Ser Pro Met Leu Ile Gly Gln Lys Ser Asp Asn Ser Arg Ile Phe Ser
                315   320   325

ccc tct ggg gtt tat gaa ata gaa aaa cat gga cgt aac tat ata atg   1062
Pro Ser Gly Val Tyr Glu Ile Glu Lys His Gly Arg Asn Tyr Ile Met
        330   335   340

gga aat cgt ctt agt ctt cca aag gaa gct aat att ttt aat ttt tct   1110
Gly Asn Arg Leu Ser Leu Pro Lys Glu Ala Asn Ile Phe Asn Phe Ser
        345   350   355

tgg tta cca tca gat tca tta aaa gat gaa gaa gct aag tta gta ctt   1158
Trp Leu Pro Ser Asp Ser Leu Lys Asp Glu Glu Ala Lys Leu Val Leu
360   365   370   375

gta acc aat aat gaa aga tta gtt gta tat aat aca aaa ggt aca aga   1206
Val Thr Asn Asn Glu Arg Leu Val Val Tyr Asn Thr Lys Gly Thr Arg
                380   385   390

ctt ttt atg act gaa gaa gtg tat tat ggt tct tct gtt ggt ata gac   1254
Leu Phe Met Thr Glu Glu Val Tyr Tyr Gly Ser Ser Val Gly Ile Asp
        395   400   405

gag ccc agt aat atg cct ggt ctt gga aag tca aaa gag ctt atc cct   1302
Glu Pro Ser Asn Met Pro Gly Leu Gly Lys Ser Lys Glu Leu Ile Pro
        410   415   420

tct aaa tat ttt atc cca gga cgg atg att cct att aat ctt gat tca   1350
Ser Lys Tyr Phe Ile Pro Gly Arg Met Ile Pro Ile Asn Leu Asp Ser

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          425                 430                 435

atg ggg aaa tgg gag ttg ctt gta agc aag cca att tct gtt gca gca    1398
Met Gly Lys Trp Glu Leu Leu Val Ser Lys Pro Ile Ser Val Ala Ala
440                 445                 450                 455

aaa ttt ttt gaa aat tat aga tct ttt gct gaa ggc gaa att cag gct    1446
Lys Phe Phe Glu Asn Tyr Arg Ser Phe Ala Glu Gly Glu Ile Gln Ala
                    460                 465                 470

tta aca tgg gac ggc tta gga tta ggt ctt gta tgg aat aca cgt cgt    1494
Leu Thr Trp Asp Gly Leu Gly Leu Gly Leu Val Trp Asn Thr Arg Arg
                475                 480                 485

att aag gga act att aca gat ttt gcc tta gct gat atg aat aat gat    1542
Ile Lys Gly Thr Ile Thr Asp Phe Ala Leu Ala Asp Met Asn Asn Asp
            490                 495                 500

ggg aag tta gac tta gtt gtt tcc gtt aat agc cat aca ggg att ctt    1590
Gly Lys Leu Asp Leu Val Val Ser Val Asn Ser His Thr Gly Ile Leu
        505                 510                 515

gga cta gaa aaa cga aag aca att ata gta ttt tat cct tta gag gta    1638
Gly Leu Glu Lys Arg Lys Thr Ile Ile Val Phe Tyr Pro Leu Glu Val
520                 525                 530                 535

gat aaa caa ggt atc cct aag gct gtt gaa gat aac taa ttttttccta    1687
Asp Lys Gln Gly Ile Pro Lys Ala Val Glu Asp Asn
                540                 545

ttaattattt ttttattctg atagttaa                                     1715


<210> 6
<211> 547
<212> PRT
<213> Lawsonia intracellularis

<400> 6

Met His Gln Lys Ser Cys Leu Val Ala Leu Cys Ile Met Phe Ile Ile
1               5                   10                  15


Met Val Gln Val Leu Gln Ala Asn Ala Ala Ser Tyr Val Val Leu Pro
                20                  25                  30


Phe Lys Val Asn Ala Pro Pro Ser Tyr Thr Tyr Leu Glu Lys Ala Ile
            35                  40                  45


Pro Ser Met Leu Thr Ser Arg Leu Tyr Trp Glu Glu Arg Phe Gln Pro
        50                  55                  60


Ile Pro Asp Ala Asn Ala Ile Lys Ala Gly Lys Val Glu Asp Ile Lys
65                  70                  75                  80


Glu Met Asp Lys Ala Arg Ile Ala Thr Gly Ala Asp Tyr Leu Ile Trp
                85                  90                  95


Gly Gln Val Asn Ile Val Gly Asp Glu Ala Thr Leu Asp Val Gln Val
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                    100                 105                     110


      Cys Asp Ile Glu Gly Ser Ile Trp Arg Lys Ser Lys Asn Thr Lys Val
              115                 120                 125


      Asp Asn Leu Ile Thr Ala Leu Gln Asp Thr Ala Asp Ala Ile Asn Ser
          130                 135                 140


      Glu Leu Phe Gly Arg Ala Thr Thr Lys Pro Ser Ser Lys Ala Thr Ile
      145                 150                 155                 160


      Val Ala Gln Met Asn Ser Gly Leu Ile Lys Gly Lys Gly Asn Glu Asn
                      165                 170                 175


      Gln Ser Tyr Leu Asn Pro Glu Phe Arg Tyr Gln Gly Ser Asn Leu Ser
                  180                 185                 190


      Arg Gly Arg Ser Gln Ala Leu Pro Phe Ala Ser Val Gly Ile Val Val
                  195                 200                 205


      Gly Asp Phe Ile Gly Asp Asn Lys Asn Glu Val Ala Ile Leu Ser Glu
          210                 215                 220


      Tyr Lys Val His Ile Tyr Arg Trp Glu Glu Glu Arg Leu Ala Leu Leu
      225                 230                 235                 240


      Gly Glu Tyr Lys Phe Pro Arg Ser Leu Gln Ser Leu His Ile Arg Ala
                      245                 250                 255


      Phe Asp Val Asp His Asp Gly Val Gln Glu Ile Ile Val Ser Cys Phe
                  260                 265                 270


      Asp Pro Ser Tyr Ala Lys Pro Tyr Ser Phe Ile Leu Ser Phe Lys Asn
                  275                 280                 285


      Arg Val Phe Lys Glu Leu Ala Thr Asn Leu Pro Phe Tyr Leu Asn Val
          290                 295                 300


      Val Lys Leu Pro Pro Asp Phe Ser Pro Met Leu Ile Gly Gln Lys Ser
      305                 310                 315                 320


      Asp Asn Ser Arg Ile Phe Ser Pro Ser Gly Val Tyr Glu Ile Glu Lys
                  325                 330                 335


      His Gly Arg Asn Tyr Ile Met Gly Asn Arg Leu Ser Leu Pro Lys Glu
                  340                 345                 350


      Ala Asn Ile Phe Asn Phe Ser Trp Leu Pro Ser Asp Ser Leu Lys Asp
              355                 360                 365
```

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Glu Glu Ala Lys Leu Val Leu Val Thr Asn Asn Glu Arg Leu Val Val
    370             375             380

Tyr Asn Thr Lys Gly Thr Arg Leu Phe Met Thr Glu Glu Val Tyr Tyr
385             390             395             400

Gly Ser Ser Val Gly Ile Asp Glu Pro Ser Asn Met Pro Gly Leu Gly
            405             410             415

Lys Ser Lys Glu Leu Ile Pro Ser Lys Tyr Phe Ile Pro Gly Arg Met
        420             425             430

Ile Pro Ile Asn Leu Asp Ser Met Gly Lys Trp Glu Leu Leu Val Ser
        435             440             445

Lys Pro Ile Ser Val Ala Ala Lys Phe Phe Glu Asn Tyr Arg Ser Phe
    450             455             460

Ala Glu Gly Glu Ile Gln Ala Leu Thr Trp Asp Gly Leu Gly Leu Gly
465             470             475             480

Leu Val Trp Asn Thr Arg Arg Ile Lys Gly Thr Ile Thr Asp Phe Ala
            485             490             495

Leu Ala Asp Met Asn Asn Asp Gly Lys Leu Asp Leu Val Val Ser Val
            500             505             510

Asn Ser His Thr Gly Ile Leu Gly Leu Glu Lys Arg Lys Thr Ile Ile
        515             520             525

Val Phe Tyr Pro Leu Glu Val Asp Lys Gln Gly Ile Pro Lys Ala Val
    530             535             540

Glu Asp Asn
545


<210>  7
<211>  1564
<212>  DNA
<213>  Lawsonia intracellularis


<220>
<221>  CDS
<222>  (41)..(1522)


<400>  7
agaagtatgt tctataagta gagtaaggaa tataaaaat atg gtt agt tat att        55
                                            Met Val Ser Tyr Ile
                                            1               5
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cgt tta tta gga agt ata ttt tta gta tta gca att ttt ggt tgt ggc      103
Arg Leu Leu Gly Ser Ile Phe Leu Val Leu Ala Ile Phe Gly Cys Gly
              10              15                  20

gct cag ttt aat aaa ccc tct tta ctt gat gaa acc cct ata gat tac      151
Ala Gln Phe Asn Lys Pro Ser Leu Leu Asp Glu Thr Pro Ile Asp Tyr
              25              30                  35

agt tct gta ctt tct gat tac ata gta gaa tta gaa aaa gaa cca ctt      199
Ser Ser Val Leu Ser Asp Tyr Ile Val Glu Leu Glu Lys Glu Pro Leu
          40              45              50

cag tat ata tta cta aaa aaa gaa aaa ttt tct caa atg gag ata tat      247
Gln Tyr Ile Leu Leu Lys Lys Glu Lys Phe Ser Gln Met Glu Ile Tyr
          55              60              65

aat tat caa ttc aca tca caa cat tgg tct cca gat aat ttt gta tca      295
Asn Tyr Gln Phe Thr Ser Gln His Trp Ser Pro Asp Asn Phe Val Ser
70              75              80                  85

cct gct ata tgg gaa cat cag gta gat ata tat atc cct cac cat cca      343
Pro Ala Ile Trp Glu His Gln Val Asp Ile Tyr Ile Pro His His Pro
                  90              95                  100

gtt tca gaa cgt gca ctt ctt atc atc aat aat ggt att aat aat ggt      391
Val Ser Glu Arg Ala Leu Leu Ile Ile Asn Asn Gly Ile Asn Asn Gly
                  105             110                 115

aca ttt ttt act tct cct aaa gct cca act gat ttt act cca gaa gta      439
Thr Phe Phe Thr Ser Pro Lys Ala Pro Thr Asp Phe Thr Pro Glu Val
          120             125             130

tta gaa gaa atc gct cgt tca aca aaa act gta gtc att gct cta agt      487
Leu Glu Glu Ile Ala Arg Ser Thr Lys Thr Val Val Ile Ala Leu Ser
          135             140             145

gat atc cca aat cag tat ctt act tat aga ggt gac tgg aga ttt ctt      535
Asp Ile Pro Asn Gln Tyr Leu Thr Tyr Arg Gly Asp Trp Arg Phe Leu
150             155             160                 165

aag gaa gat gaa agt att gct atg agt tgg tct agt ttt tta caa gat      583
Lys Glu Asp Glu Ser Ile Ala Met Ser Trp Ser Ser Phe Leu Gln Asp
                  170             175                 180

cca gaa agt cgg tac aca aga cct ctc tat gtc cct atg gtt gca gca      631
Pro Glu Ser Arg Tyr Thr Arg Pro Leu Tyr Val Pro Met Val Ala Ala
                  185             190                 195

gtt tct cag gca atg act ctt gca gaa aag gag tta caa gca tta aaa      679
Val Ser Gln Ala Met Thr Leu Ala Glu Lys Glu Leu Gln Ala Leu Lys
              200             205             210

att aag cat ttt att gta tct ggt gtg tca aag cgt gga tgg aca aca      727
Ile Lys His Phe Ile Val Ser Gly Val Ser Lys Arg Gly Trp Thr Thr
          215             220             225

tgg ctt tca gct att gct gac tca cga gta gat gct att acc ccg ttt      775
Trp Leu Ser Ala Ile Ala Asp Ser Arg Val Asp Ala Ile Thr Pro Phe
230             235             240                 245

gtt att gat gca ttg aat act cgg aaa gtc ctt gga cat atg tat aaa      823
Val Ile Asp Ala Leu Asn Thr Arg Lys Val Leu Gly His Met Tyr Lys
              250             255             260

aca tat gga aat aat tgg cct ata gca ttt tat cca tat tat aga ttt      871
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         Thr Tyr Gly Asn Asn Trp Pro Ile Ala Phe Tyr Pro Tyr Tyr Arg Phe
                     265             270             275

    gat tta gat aaa caa cta gat aca gtt cct ttt ttc aat ctt atg aat       919
    Asp Leu Asp Lys Gln Leu Asp Thr Val Pro Phe Phe Asn Leu Met Asn
            280             285             290

    att gtt gat cca tat aga tat tta gga aca cca tat aag tct cga ctt       967
    Ile Val Asp Pro Tyr Arg Tyr Leu Gly Thr Pro Tyr Lys Ser Arg Leu
        295             300             305

    gct atc cct aaa tat att gta aat gca agt gga gat gat ttt tat gtc      1015
    Ala Ile Pro Lys Tyr Ile Val Asn Ala Ser Gly Asp Asp Phe Tyr Val
    310             315             320             325

    cct gat aat tca agt ttt tac tat gat gat ctc cct gga gag aaa gca      1063
    Pro Asp Asn Ser Ser Phe Tyr Tyr Asp Asp Leu Pro Gly Glu Lys Ala
                330             335             340

    tta cgt ttt gca cca aac tca aat cat cat ggg ata tta aat ttc aca      1111
    Leu Arg Phe Ala Pro Asn Ser Asn His His Gly Ile Leu Asn Phe Thr
                345             350             355

    aaa caa tcg ctt att cct ttt gtg aat aga gta caa aaa ggt att tca      1159
    Lys Gln Ser Leu Ile Pro Phe Val Asn Arg Val Gln Lys Gly Ile Ser
                360             365             370

    acg cca gtt tta gat att tcc aca gag atg acg gaa cga gtt caa tat      1207
    Thr Pro Val Leu Asp Ile Ser Thr Glu Met Thr Glu Arg Val Gln Tyr
        375             380             385

    gtg act gtt cgt ttt tct gaa gtt cca gag aag ata gta ctt tgg aaa      1255
    Val Thr Val Arg Phe Ser Glu Val Pro Glu Lys Ile Val Leu Trp Lys
    390             395             400             405

    gca gca aat cca gag tca cga gat ttt cgt tat gcc tgt cgt gtt agg      1303
    Ala Ala Asn Pro Glu Ser Arg Asp Phe Arg Tyr Ala Cys Arg Val Arg
                410             415             420

    tac atg gaa aca cca tta cac ctt tct gca aca ggg gaa gtt agc gtt      1351
    Tyr Met Glu Thr Pro Leu His Leu Ser Ala Thr Gly Glu Val Ser Val
                425             430             435

    tca tta gag atc cct tct gta gga tgg caa gct gct ttt att gaa gct      1399
    Ser Leu Glu Ile Pro Ser Val Gly Trp Gln Ala Ala Phe Ile Glu Ala
                440             445             450

    aca ttt aaa gat ggt ttt gtt gca aca aca cca gtg tat att tta cca      1447
    Thr Phe Lys Asp Gly Phe Val Ala Thr Thr Pro Val Tyr Ile Leu Pro
                455             460             465

    aaa gat ata tat cca cct ata aaa ata cca cct gta cat gga tta tta      1495
    Lys Asp Ile Tyr Pro Pro Ile Lys Ile Pro Pro Val His Gly Leu Leu
    470             475             480             485

    tgt aag ttt gta cat ggt cga acc tag taactagtag ttgttgtact            1542
    Cys Lys Phe Val His Gly Arg Thr
                490

    gataatctaa aaggatatag at                                             1564


    <210>  8
    <211>  493
    <212>  PRT
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<213> Lawsonia intracellularis

<400> 8

Met Val Ser Tyr Ile Arg Leu Leu Gly Ser Ile Phe Leu Val Leu Ala
1   5   10   15

Ile Phe Gly Cys Gly Ala Gln Phe Asn Lys Pro Ser Leu Leu Asp Glu
           20   25   30

Thr Pro Ile Asp Tyr Ser Ser Val Leu Ser Asp Tyr Ile Val Glu Leu
           35   40   45

Glu Lys Glu Pro Leu Gln Tyr Ile Leu Leu Lys Lys Glu Lys Phe Ser
      50   55   60

Gln Met Glu Ile Tyr Asn Tyr Gln Phe Thr Ser Gln His Trp Ser Pro
65   70   75   80

Asp Asn Phe Val Ser Pro Ala Ile Trp Glu His Gln Val Asp Ile Tyr
                85   90   95

Ile Pro His His Pro Val Ser Glu Arg Ala Leu Leu Ile Ile Asn Asn
           100   105   110

Gly Ile Asn Asn Gly Thr Phe Phe Thr Ser Pro Lys Ala Pro Thr Asp
           115   120   125

Phe Thr Pro Glu Val Leu Glu Glu Ile Ala Arg Ser Thr Lys Thr Val
      130   135   140

Val Ile Ala Leu Ser Asp Ile Pro Asn Gln Tyr Leu Thr Tyr Arg Gly
145   150   155   160

Asp Trp Arg Phe Leu Lys Glu Asp Glu Ser Ile Ala Met Ser Trp Ser
           165   170   175

Ser Phe Leu Gln Asp Pro Glu Ser Arg Tyr Thr Arg Pro Leu Tyr Val
           180   185   190

Pro Met Val Ala Ala Val Ser Gln Ala Met Thr Leu Ala Glu Lys Glu
           195   200   205

Leu Gln Ala Leu Lys Ile Lys His Phe Ile Val Ser Gly Val Ser Lys
      210   215   220

Arg Gly Trp Thr Thr Trp Leu Ser Ala Ile Ala Asp Ser Arg Val Asp
225   230   235   240

Ala Ile Thr Pro Phe Val Ile Asp Ala Leu Asn Thr Arg Lys Val Leu

```
                      245                  250                  255


       Gly His Met Tyr Lys Thr Tyr Gly Asn Asn Trp Pro Ile Ala Phe Tyr
               260              265              270


       Pro Tyr Tyr Arg Phe Asp Leu Asp Lys Gln Leu Asp Thr Val Pro Phe
               275              280              285


       Phe Asn Leu Met Asn Ile Val Asp Pro Tyr Arg Tyr Leu Gly Thr Pro
           290              295              300


       Tyr Lys Ser Arg Leu Ala Ile Pro Lys Tyr Ile Val Asn Ala Ser Gly
       305              310              315              320


       Asp Asp Phe Tyr Val Pro Asp Asn Ser Ser Phe Tyr Tyr Asp Asp Leu
                   325              330              335


       Pro Gly Glu Lys Ala Leu Arg Phe Ala Pro Asn Ser Asn His His Gly
               340              345              350


       Ile Leu Asn Phe Thr Lys Gln Ser Leu Ile Pro Phe Val Asn Arg Val
               355              360              365


       Gln Lys Gly Ile Ser Thr Pro Val Leu Asp Ile Ser Thr Glu Met Thr
       370              375              380


  ı    Glu Arg Val Gln Tyr Val Thr Val Arg Phe Ser Glu Val Pro Glu Lys
       385              390              395              400


       Ile Val Leu Trp Lys Ala Ala Asn Pro Glu Ser Arg Asp Phe Arg Tyr
                   405              410              415


       Ala Cys Arg Val Arg Tyr Met Glu Thr Pro Leu His Leu Ser Ala Thr
                   420              425              430


       Gly Glu Val Ser Val Ser Leu Glu Ile Pro Ser Val Gly Trp Gln Ala
               435              440              445


       Ala Phe Ile Glu Ala Thr Phe Lys Asp Gly Phe Val Ala Thr Thr Pro
           450              455              460


       Val Tyr Ile Leu Pro Lys Asp Ile Tyr Pro Pro Ile Lys Ile Pro Pro
       465              470              475              480


       Val His Gly Leu Leu Cys Lys Phe Val His Gly Arg Thr
                   485              490
```

<210> 9
<211> 2096

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<212> DNA
<213> Lawsonia intracellularis


<220>
<221> CDS
<222> (12)..(2096)

<400> 9
aggacaaaac t atg gcg gat tat ctt tca gga gga att tct ttt gga gga        50
           Met Ala Asp Tyr Leu Ser Gly Gly Ile Ser Phe Gly Gly
           1           5                   10

att ggt agt gga acc gat ttc caa gct atg att gat caa ctt aag aaa        98
Ile Gly Ser Gly Thr Asp Phe Gln Ala Met Ile Asp Gln Leu Lys Lys
    15              20                  25

att gag ctt att cct aaa aat aga ctt gta gtt tcc cat gaa caa tgg       146
Ile Glu Leu Ile Pro Lys Asn Arg Leu Val Val Ser His Glu Gln Trp
30              35                  40                  45

aca aaa aaa tat aaa gca ttt gaa gag ctt ata aaa aca gtt aaa gat       194
Thr Lys Lys Tyr Lys Ala Phe Glu Glu Leu Ile Lys Thr Val Lys Asp
                50                  55                  60

act gaa gcg tct tta agt aag cta agt tct gtt ggt gct att tta aaa       242
Thr Glu Ala Ser Leu Ser Lys Leu Ser Ser Val Gly Ala Ile Leu Lys
            65                  70                  75

aaa gaa ggt tct gtt tca aat act tct gtt gca agc gtt aag gca agt       290
Lys Glu Gly Ser Val Ser Asn Thr Ser Val Ala Ser Val Lys Ala Ser
            80                  85                  90

tct gat gca tct gat gga aca cat aca att gat gtg aaa cag ctt gca       338
Ser Asp Ala Ser Asp Gly Thr His Thr Ile Asp Val Lys Gln Leu Ala
        95                  100                 105

aca aac acg att ctt tct aat aat cat att ttt gat tct aaa act gaa       386
Thr Asn Thr Ile Leu Ser Asn Asn His Ile Phe Asp Ser Lys Thr Glu
110             115                 120                 125

agt att aat aat aca ggt tca cct ggt atc ttt gct tat gag tat aaa       434
Ser Ile Asn Asn Thr Gly Ser Pro Gly Ile Phe Ala Tyr Glu Tyr Lys
                130                 135                 140

ggg gaa cta cat gaa gtt gaa gtt cct cca ggt agt gat ctt gaa tat       482
Gly Glu Leu His Glu Val Glu Val Pro Pro Gly Ser Asp Leu Glu Tyr
            145                 150                 155

ctt gca aca tta ata aac aaa gat tct aat aat cct ggt gtt aaa gca       530
Leu Ala Thr Leu Ile Asn Lys Asp Ser Asn Asn Pro Gly Val Lys Ala
        160                 165                 170

aac ctt atc aag act ggc gat ggc tat atg ttt agt ctt gaa gga act       578
Asn Leu Ile Lys Thr Gly Asp Gly Tyr Met Phe Ser Leu Glu Gly Thr
        175                 180                 185

gaa act ggt gca aat gcg act tta tct att tca aat aag aca acg ctt       626
Glu Thr Gly Ala Asn Ala Thr Leu Ser Ile Ser Asn Lys Thr Thr Leu
190                 195                 200                 205

cca gac ttt aaa gca tct gtt gct acc agc agt gca tta gct aat ggt       674
Pro Asp Phe Lys Ala Ser Val Ala Thr Ser Ser Ala Leu Ala Asn Gly
                210                 215                 220
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gaa gat aca att att aat act tca gga aca act caa caa ttt tct ttt        722
Glu Asp Thr Ile Ile Asn Thr Ser Gly Thr Thr Gln Gln Phe Ser Phe
            225             230             235

gaa tac aat gga aga aca ttt act ttc gat att cct tca gga aca aca        770
Glu Tyr Asn Gly Arg Thr Phe Thr Phe Asp Ile Pro Ser Gly Thr Thr
            240             245             250

gca aaa gaa ctc caa aca gct ata aat gaa aat aca aaa aat aca gga        818
Ala Lys Glu Leu Gln Thr Ala Ile Asn Glu Asn Thr Lys Asn Thr Gly
    255             260             265

gta cgt gca act ttt gaa aaa cat ggc tca gat ata gta ttg caa tta       866
Val Arg Ala Thr Phe Glu Lys His Gly Ser Asp Ile Val Leu Gln Leu
270             275             280                     285

gaa gga aca gtt cct aat caa caa gtt aaa gta acc gct agc cct act       914
Glu Gly Thr Val Pro Asn Gln Gln Val Lys Val Thr Ala Ser Pro Thr
                290             295             300

gat ctt gga agt ttc aca tct tcg ggt caa gca ggc tgg aat aaa cgt       962
Asp Leu Gly Ser Phe Thr Ser Ser Gly Gln Ala Gly Trp Asn Lys Arg
            305             310             315

gat tct caa gat gct att ttt aat att aat ggt tgg gac caa gaa ctt      1010
Asp Ser Gln Asp Ala Ile Phe Asn Ile Asn Gly Trp Asp Gln Glu Leu
            320             325             330

aca tct tct aca aat gaa ctt aca gaa gtt atc cca gga ctt caa att      1058
Thr Ser Ser Thr Asn Glu Leu Thr Glu Val Ile Pro Gly Leu Gln Ile
    335             340             345

aca cta ctt tcc gaa ggg aaa aca caa att aca att cag act tct act      1106
Thr Leu Leu Ser Glu Gly Lys Thr Gln Ile Thr Ile Gln Thr Ser Thr
350             355             360             365

gac gaa gta aaa aaa caa gtt gag aaa gca gta gag tct ata aat aat      1154
Asp Glu Val Lys Lys Gln Val Glu Lys Ala Val Glu Ser Ile Asn Asn
            370             375             380

gtt ctt tcc aaa att caa gag tta act aaa gca aca gct gaa gac aaa      1202
Val Leu Ser Lys Ile Gln Glu Leu Thr Lys Ala Thr Ala Glu Asp Lys
            385             390             395

gat gat agt aaa gac act tct agt tct tca agt aaa att cca tca tat      1250
Asp Asp Ser Lys Asp Thr Ser Ser Ser Ser Ser Lys Ile Pro Ser Tyr
            400             405             410

tta caa agt cct aca aaa gtg aag gct gga cta ttt aca ggt gat act      1298
Leu Gln Ser Pro Thr Lys Val Lys Ala Gly Leu Phe Thr Gly Asp Thr
    415             420             425

ggc ata caa atg ctt agt act aga ctt aag tct atc ttt tct tct aat      1346
Gly Ile Gln Met Leu Ser Thr Arg Leu Lys Ser Ile Phe Ser Ser Asn
430             435             440             445

ggt cta ggt ttt tct cct aaa caa aca caa gat ggt cca ggg gat cta      1394
Gly Leu Gly Phe Ser Pro Lys Gln Thr Gln Asp Gly Pro Gly Asp Leu
            450             455             460

ttt tca tca ctt gct tca att ggt att gtc gta gat gct gat gag ggt      1442
Phe Ser Ser Leu Ala Ser Ile Gly Ile Val Val Asp Ala Asp Glu Gly
            465             470             475

agt gaa act ttt gga caa ctt aaa att tta gat aga gaa aca att ggt      1490
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          Ser Glu Thr Phe Gly Gln Leu Lys Ile Leu Asp Arg Glu Thr Ile Gly
                  480                 485                 490

          cct gat gca cct tat aca act ctt gat gag gca tta aaa aaa gat cca    1538
          Pro Asp Ala Pro Tyr Thr Thr Leu Asp Glu Ala Leu Lys Lys Asp Pro
                  495                 500                 505

          caa gca gta gca gat ata tta gct ggt agt tct gga ata tct gat tca    1586
          Gln Ala Val Ala Asp Ile Leu Ala Gly Ser Ser Gly Ile Ser Asp Ser
          510                 515                 520                 525

          aca gat ttt tct tat caa gat cat att gtt gga aaa aca caa gct ggt    1634
          Thr Asp Phe Ser Tyr Gln Asp His Ile Val Gly Lys Thr Gln Ala Gly
                          530                 535                 540

          aca tat gat gta aag tat tct gta gat gca agt ggt act ata gga gac    1682
          Thr Tyr Asp Val Lys Tyr Ser Val Asp Ala Ser Gly Thr Ile Gly Asp
                          545                 550                 555

          gtt tac att gga ggt gta aaa gct tct cta tct gat cct gca aaa aat    1730
          Val Tyr Ile Gly Gly Val Lys Ala Ser Leu Ser Asp Pro Ala Lys Asn
                  560                 565                 570

          ata tat acg gtc aca tct ggt cct gct aca ggt ctt agt ata gca gtt    1778
          Ile Tyr Thr Val Thr Ser Gly Pro Ala Thr Gly Leu Ser Ile Ala Val
                  575                 580                 585

          aat aat cgt act cca ggt atc aat gta gaa agt act gta aga gtc aaa    1826
          Asn Asn Arg Thr Pro Gly Ile Asn Val Glu Ser Thr Val Arg Val Lys
          590                 595                 600                 605

          caa ggt aaa ctt agc caa ata caa gaa gca ctt aaa gct gaa gta cag    1874
          Gln Gly Lys Leu Ser Gln Ile Gln Glu Ala Leu Lys Ala Glu Val Gln
                          610                 615                 620

          caa gat cct tta aaa gaa aac aca ggt cct tta att atc atg caa gat    1922
          Gln Asp Pro Leu Lys Glu Asn Thr Gly Pro Leu Ile Ile Met Gln Asp
                          625                 630                 635

          aac tat aag gat gtt atg aaa aat ctt gag aca aga ata gaa aaa gaa    1970
          Asn Tyr Lys Asp Val Met Lys Asn Leu Glu Thr Arg Ile Glu Lys Glu
                  640                 645                 650

          aca caa aga gtt act agt tgg gaa cgt atg atg cgt tta aaa ttt tct    2018
          Thr Gln Arg Val Thr Ser Trp Glu Arg Met Met Arg Leu Lys Phe Ser
                  655                 660                 665

          aga ctt gat gct gta tta gca aaa tat aat cag atg atg tca gca aat    2066
          Arg Leu Asp Ala Val Leu Ala Lys Tyr Asn Gln Met Met Ser Ala Asn
          670                 675                 680                 685

          gct tct agt tta ggg caa ctt ggt gca taa                            2096
          Ala Ser Ser Leu Gly Gln Leu Gly Ala
                          690
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<210> 10
<211> 694
<212> PRT
<213> Lawsonia intracellularis

<400> 10

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          Met Ala Asp Tyr Leu Ser Gly Gly Ile Ser Phe Gly Gly Ile Gly Ser
          1               5                   10                  15
```

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Gly Thr Asp Phe Gln Ala Met Ile Asp Gln Leu Lys Lys Ile Glu Leu
        20              25              30

Ile Pro Lys Asn Arg Leu Val Val Ser His Glu Gln Trp Thr Lys Lys
        35              40              45

Tyr Lys Ala Phe Glu Glu Leu Ile Lys Thr Val Lys Asp Thr Glu Ala
    50              55              60

Ser Leu Ser Lys Leu Ser Ser Val Gly Ala Ile Leu Lys Lys Glu Gly
65              70              75              80

Ser Val Ser Asn Thr Ser Val Ala Ser Val Lys Ala Ser Ser Asp Ala
                85              90              95

Ser Asp Gly Thr His Thr Ile Asp Val Lys Gln Leu Ala Thr Asn Thr
            100             105             110

Ile Leu Ser Asn Asn His Ile Phe Asp Ser Lys Thr Glu Ser Ile Asn
        115             120             125

Asn Thr Gly Ser Pro Gly Ile Phe Ala Tyr Glu Tyr Lys Gly Glu Leu
    130             135             140

His Glu Val Glu Val Pro Pro Gly Ser Asp Leu Glu Tyr Leu Ala Thr
145             150         .       155             160

Leu Ile Asn Lys Asp Ser Asn Asn Pro Gly Val Lys Ala Asn Leu Ile
            165             170             175

Lys Thr Gly Asp Gly Tyr Met Phe Ser Leu Glu Gly Thr Glu Thr Gly
        180             185             190

Ala Asn Ala Thr Leu Ser Ile Ser Asn Lys Thr Thr Leu Pro Asp Phe
        195             200             205

Lys Ala Ser Val Ala Thr Ser Ser Ala Leu Ala Asn Gly Glu Asp Thr
    210             215             220

Ile Ile Asn Thr Ser Gly Thr Thr Gln Gln Phe Ser Phe Glu Tyr Asn
225             230             235             240

Gly Arg Thr Phe Thr Phe Asp Ile Pro Ser Gly Thr Thr Ala Lys Glu
            245             250             255

Leu Gln Thr Ala Ile Asn Glu Asn Thr Lys Asn Thr Gly Val Arg Ala
        260             265             270
```

```
Thr Phe Glu Lys His Gly Ser Asp Ile Val Leu Gln Leu Glu Gly Thr
        275             280             285


Val Pro Asn Gln Gln Val Lys Val Thr Ala Ser Pro Thr Asp Leu Gly
        290             295             300


Ser Phe Thr Ser Ser Gly Gln Ala Gly Trp Asn Lys Arg Asp Ser Gln
305             310             315             320


Asp Ala Ile Phe Asn Ile Asn Gly Trp Asp Gln Glu Leu Thr Ser Ser
            325             330             335


Thr Asn Glu Leu Thr Glu Val Ile Pro Gly Leu Gln Ile Thr Leu Leu
            340             345             350


Ser Glu Gly Lys Thr Gln Ile Thr Ile Gln Thr Ser Thr Asp Glu Val
        355             360             365


Lys Lys Gln Val Glu Lys Ala Val Glu Ser Ile Asn Asn Val Leu Ser
        370             375             380


Lys Ile Gln Glu Leu Thr Lys Ala Thr Ala Glu Asp Lys Asp Asp Ser
385             390             395             400


Lys Asp Thr Ser Ser Ser Ser Ser Lys Ile Pro Ser Tyr Leu Gln Ser
            405             410             415


Pro Thr Lys Val Lys Ala Gly Leu Phe Thr Gly Asp Thr Gly Ile Gln
            420             425             430


Met Leu Ser Thr Arg Leu Lys Ser Ile Phe Ser Ser Asn Gly Leu Gly
        435             440             445


Phe Ser Pro Lys Gln Thr Gln Asp Gly Pro Gly Asp Leu Phe Ser Ser
    450             455             460


Leu Ala Ser Ile Gly Ile Val Val Asp Ala Asp Glu Gly Ser Glu Thr
465             470             475             480


Phe Gly Gln Leu Lys Ile Leu Asp Arg Glu Thr Ile Gly Pro Asp Ala
            485             490             495


Pro Tyr Thr Thr Leu Asp Glu Ala Leu Lys Lys Asp Pro Gln Ala Val
            500             505             510


Ala Asp Ile Leu Ala Gly Ser Ser Gly Ile Ser Asp Ser Thr Asp Phe
            515             520             525
```

```
Ser Tyr Gln Asp His Ile Val Gly Lys Thr Gln Ala Gly  Thr Tyr Asp
    530             535             540

Val Lys Tyr Ser Val Asp Ala Ser Gly Thr Ile Gly Asp Val Tyr Ile
545             550             555             560

Gly Gly Val Lys Ala Ser Leu Ser Asp Pro Ala Lys Asn Ile Tyr Thr
                565             570             575

Val Thr Ser Gly Pro Ala Thr Gly Leu Ser Ile Ala Val Asn Asn Arg
            580             585             590

Thr Pro Gly Ile Asn Val Glu Ser Thr Val Arg Val Lys Gln Gly Lys
        595             600             605

Leu Ser Gln Ile Gln Glu Ala Leu Lys Ala Glu Val Gln Gln Asp Pro
    610             615             620

Leu Lys Glu Asn Thr Gly Pro Leu Ile Ile Met Gln Asp Asn Tyr Lys
625             630             635             640

Asp Val Met Lys Asn Leu Glu Thr Arg Ile Glu Lys Glu Thr Gln Arg
            645             650             655

Val Thr Ser Trp Glu Arg Met Met Arg Leu Lys Phe Ser Arg Leu Asp
            660             665             670

Ala Val Leu Ala Lys Tyr Asn Gln Met Met Ser Ala Asn Ala Ser Ser
            675             680             685

Leu Gly Gln Leu Gly Ala
    690
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<210>  11
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<212>  DNA
<213>  Lawsonia intracellularis


<220>
<221>  CDS
<222>  (13)..(1200)

<400>  11
taggagatag tt atg gct aat gtt agt gga atc cct gca cca  cga tta ctt       51
           Met Ala Asn Val Ser Gly Ile Pro Ala Pro  Arg Leu Leu
           1               5               10

tcc aca aca aat caa atg acc aat gca gct gct ggt aat act aat aga          99
Ser Thr Thr Asn Gln Met Thr Asn Ala Ala Ala Gly Asn Thr Asn Arg
15              20              25

gct acc ggt agt atg aac ggt cgt aat ctc aca caa ata aaa aca cct         147
Ala Thr Gly Ser Met Asn Gly Arg Asn Leu Thr Gln Ile Lys Thr Pro
```

```
           30                   35                   40                   45

cag tcc atg att gat aat gct tca gaa gaa tta aca act tct ctt gaa              195
Gln Ser Met Ile Asp Asn Ala Ser Glu Glu Leu Thr Thr Ser Leu Glu
                50                   55                   60

tct aaa agc agt gac gac ttt gca att aaa gat cgt aaa aga caa ggg            243
Ser Lys Ser Ser Asp Asp Phe Ala Ile Lys Asp Arg Lys Arg Gln Gly
                65                   70                   75

aaa gga tct gat tct cta tta aaa atg gtt caa gaa tat aca gag ctg            291
Lys Gly Ser Asp Ser Leu Leu Lys Met Val Gln Glu Tyr Thr Glu Leu
                80                   85                   90

acg aat gat gat acc cgt aat gct aaa aga gct atg tta tcc cag gta            339
Thr Asn Asp Asp Thr Arg Asn Ala Lys Arg Ala Met Leu Ser Gln Val
                95                  100                  105

tta cgt gca agt caa agt tca caa gat gta ctc gaa aaa aca tta gaa            387
Leu Arg Ala Ser Gln Ser Ser Gln Asp Val Leu Glu Lys Thr Leu Glu
110                  115                  120                  125

caa ttt tct aat aaa aca gat gct tgg gct tct ctt gca gaa att gca            435
Gln Phe Ser Asn Lys Thr Asp Ala Trp Ala Ser Leu Ala Glu Ile Ala
                130                  135                  140

caa gaa tat ggt gca gaa tct cca cag cca aca gga tta aaa tct gta            483
Gln Glu Tyr Gly Ala Glu Ser Pro Gln Pro Thr Gly Leu Lys Ser Val
                145                  150                  155

tta gat gct atg gag aca tta gaa aat gag ttt ggt gat gaa att aaa            531
Leu Asp Ala Met Glu Thr Leu Glu Asn Glu Phe Gly Asp Glu Ile Lys
                160                  165                  170

gca gga cta aaa gga gct cta aat tca aaa gaa ttt act gat ata ggc            579
Ala Gly Leu Lys Gly Ala Leu Asn Ser Lys Glu Phe Thr Asp Ile Gly
                175                  180                  185

agt gca gca cag tta aga gat ctt tat aca aca aca gta act ata aca            627
Ser Ala Ala Gln Leu Arg Asp Leu Tyr Thr Thr Thr Val Thr Ile Thr
190                  195                  200                  205

gct gca cct gat gca gtg tta gca aga ctt ctt gaa gaa tat gag agt            675
Ala Ala Pro Asp Ala Val Leu Ala Arg Leu Leu Glu Glu Tyr Glu Ser
                210                  215                  220

gat gat gat ctg gat aga gcc att gat ttc ctt cta tct aca ctt ggt            723
Asp Asp Asp Leu Asp Arg Ala Ile Asp Phe Leu Leu Ser Thr Leu Gly
                225                  230                  235

gga gag ctt gaa tca gct gat cca agt atg gat aaa gta cat ctt caa            771
Gly Glu Leu Glu Ser Ala Asp Pro Ser Met Asp Lys Val His Leu Gln
                240                  245                  250

agt gta atg ggt gat att gaa aaa aca caa caa ctt cat agc tct cat            819
Ser Val Met Gly Asp Ile Glu Lys Thr Gln Gln Leu His Ser Ser His
255                  260                  265

aaa caa tgt act aca gcc ctt agc agg tgg aaa gag aaa cat aaa ggt            867
Lys Gln Cys Thr Thr Ala Leu Ser Arg Trp Lys Glu Lys His Lys Gly
270                  275                  280                  285

ggg ggg gaa aat agt aca cta act cct tta gaa atg atg cgt gaa cta            915
Gly Gly Glu Asn Ser Thr Leu Thr Pro Leu Glu Met Met Arg Glu Leu
                290                  295                  300
```

```
att gca cta aaa aat gaa aat ttt att tct cct tcc tct ata gat aaa    963
Ile Ala Leu Lys Asn Glu Asn Phe Ile Ser Pro Ser Ser Ile Asp Lys
            305                 310                 315

att gtt gat caa gct gat ccc caa gat att gaa aaa gaa gtc ctt ttt   1011
Ile Val Asp Gln Ala Asp Pro Gln Asp Ile Glu Lys Glu Val Leu Phe
            320                 325                 330

tta caa gag atg tta gct gct gta aga aaa ttt ccc att atg gta ttt   1059
Leu Gln Glu Met Leu Ala Ala Val Arg Lys Phe Pro Ile Met Val Phe
            335                 340                 345

gat aat gtc gaa aat cgt gta aga gtt atg ggt gct gta caa gat gct   1107
Asp Asn Val Glu Asn Arg Val Arg Val Met Gly Ala Val Gln Asp Ala
350                 355                 360                 365

gtt gac gat gct gta aga aga gaa gat gaa ttc ctc ttt caa aaa gaa   1155
Val Asp Asp Ala Val Arg Arg Glu Asp Glu Phe Leu Phe Gln Lys Glu
            370                 375                 380

cat cct gat gta cca cta caa cca gat gaa aat aat ata caa taa       1200
His Pro Asp Val Pro Leu Gln Pro Asp Glu Asn Asn Ile Gln
            385                 390                 395


<210>  12
<211>  395
<212>  PRT
<213>  Lawsonia intracellularis

<400>  12

Met Ala Asn Val Ser Gly Ile Pro Ala Pro Arg Leu Leu Ser Thr Thr
1               5                   10                  15


Asn Gln Met Thr Asn Ala Ala Ala Gly Asn Thr Asn Arg Ala Thr Gly
            20                  25                  30


Ser Met Asn Gly Arg Asn Leu Thr Gln Ile Lys Thr Pro Gln Ser Met
            35                  40                  45


Ile Asp Asn Ala Ser Glu Glu Leu Thr Thr Ser Leu Glu Ser Lys Ser
        50                  55                  60


Ser Asp Asp Phe Ala Ile Lys Asp Arg Lys Arg Gln Gly Lys Gly Ser
65                  70                  75                  80


Asp Ser Leu Leu Lys Met Val Gln Glu Tyr Thr Glu Leu Thr Asn Asp
            85                  90                  95


Asp Thr Arg Asn Ala Lys Arg Ala Met Leu Ser Gln Val Leu Arg Ala
            100                 105                 110


Ser Gln Ser Ser Gln Asp Val Leu Glu Lys Thr Leu Glu Gln Phe Ser
            115                 120                 125
```

```
Asn Lys Thr Asp Ala Trp Ala Ser Leu Ala Glu Ile Ala Gln Glu Tyr
    130             135             140

Gly Ala Glu Ser Pro Gln Pro Thr Gly Leu Lys Ser Val Leu Asp Ala
145             150             155             160

Met Glu Thr Leu Glu Asn Glu Phe Gly Asp Glu Ile Lys Ala Gly Leu
            165             170             175

Lys Gly Ala Leu Asn Ser Lys Glu Phe Thr Asp Ile Gly Ser Ala Ala
            180             185             190

Gln Leu Arg Asp Leu Tyr Thr Thr Thr Val Thr Ile Thr Ala Ala Pro
        195             200             205

Asp Ala Val Leu Ala Arg Leu Leu Glu Glu Tyr Glu Ser Asp Asp Asp
    210             215             220

Leu Asp Arg Ala Ile Asp Phe Leu Leu Ser Thr Leu Gly Gly Glu Leu
225             230             235             240

Glu Ser Ala Asp Pro Ser Met Asp Lys Val His Leu Gln Ser Val Met
            245             250             255

Gly Asp Ile Glu Lys Thr Gln Gln Leu His Ser Ser His Lys Gln Cys
            260             265             270

Thr Thr Ala Leu Ser Arg Trp Lys Glu Lys His Lys Gly Gly Gly Glu
        275             280             285

Asn Ser Thr Leu Thr Pro Leu Glu Met Met Arg Glu Leu Ile Ala Leu
290             295             300

Lys Asn Glu Asn Phe Ile Ser Pro Ser Ser Ile Asp Lys Ile Val Asp
305             310             315             320

Gln Ala Asp Pro Gln Asp Ile Glu Lys Glu Val Leu Phe Leu Gln Glu
            325             330             335

Met Leu Ala Ala Val Arg Lys Phe Pro Ile Met Val Phe Asp Asn Val
            340             345             350

Glu Asn Arg Val Arg Val Met Gly Ala Val Gln Asp Ala Val Asp Asp
        355             360             365

Ala Val Arg Arg Glu Asp Glu Phe Leu Phe Gln Lys Glu His Pro Asp
    370             375             380

Val Pro Leu Gln Pro Asp Glu Asn Asn Ile Gln
```

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385                    390                    395


<210>  13
<211>  1269
<212>  DNA
<213>  Lawsonia intracellularis


<220>
<221>  CDS
<222>  (32)..(1222)

<400>  13
tgttggaaat tctctctgga ggagtaaagc a atg aca aat ttt gga gat ata          52
                                   Met Thr Asn Phe Gly Asp Ile
                                   1               5


agc gga agc tcc gca aga atg agt agc ttg atg act ggt aca tcc ggt        100
Ser Gly Ser Ser Ala Arg Met Ser Ser Leu Met Thr Gly Thr Ser Gly
        10              15                  20


gaa gaa gga ctt gaa gaa ctt gaa ggt ggt gtt cct aaa gag caa ggt        148
Glu Glu Gly Leu Glu Glu Leu Glu Gly Gly Val Pro Lys Glu Gln Gly
    25                  30                  35


ggt cca ggt aaa gga gat gct tca gag gct gct aaa ggt caa gca gca        196
Gly Pro Gly Lys Gly Asp Ala Ser Glu Ala Ala Lys Gly Gln Ala Ala
40                  45                  50                  55


gca gat agt att aat tca gct ggt ggt act gaa aag cct gga gaa gtt        244
Ala Asp Ser Ile Asn Ser Ala Gly Gly Thr Glu Lys Pro Gly Glu Val
                60                  65                  70


ggt gat aag gaa gat gta ggg gaa ggt ggc gaa ata cct gaa ggt ggt        292
Gly Asp Lys Glu Asp Val Gly Glu Gly Gly Glu Ile Pro Glu Gly Gly
            75                  80                  85


gaa ata cct gag ggt ggt gaa gaa gtt cca gag gaa ccc cca tat gtc        340
Glu Ile Pro Glu Gly Gly Glu Glu Val Pro Glu Glu Pro Pro Tyr Val
            90                  95                  100


cct cct cca ttg gtt gaa cca gct aaa atc agt aca gta aca gat ctc        388
Pro Pro Pro Leu Val Glu Pro Ala Lys Ile Ser Thr Val Thr Asp Leu
    105                 110                 115


agt acg tta atg gga tca cta cag ctg aca gag caa aaa aag aat gct        436
Ser Thr Leu Met Gly Ser Leu Gln Leu Thr Glu Gln Lys Lys Asn Ala
120                 125                 130                 135


gaa aaa aca gta aat gaa att aaa gca cag aat aaa gag caa caa gta        484
Glu Lys Thr Val Asn Glu Ile Lys Ala Gln Asn Lys Glu Gln Gln Val
                140                 145                 150


aag ttc caa gag caa att aaa aag att gag gat aat att gct gaa tct        532
Lys Phe Gln Glu Gln Ile Lys Lys Ile Glu Asp Asn Ile Ala Glu Ser
                155                 160                 165


aag aaa agt ggt ata ctt aag ttt ttc caa aag ttg ttt gca gtt att        580
Lys Lys Ser Gly Ile Leu Lys Phe Phe Gln Lys Leu Phe Ala Val Ile
            170                 175                 180


ggt gct gta cta gga gct att gga ggt gcg cta gct att gct gca ggt        628
Gly Ala Val Leu Gly Ala Ile Gly Gly Ala Leu Ala Ile Ala Ala Gly
        185                 190                 195
```

```
gct gct tca ggt aac cca tta ttg gtt gct gca ggt att atg gct att        676
Ala Ala Ser Gly Asn Pro Leu Leu Val Ala Ala Gly Ile Met Ala Ile
200             205             210             215

gta gct tca att gat gca gca atg tcg tcg cta tcg gat ggt aaa gtg        724
Val Ala Ser Ile Asp Ala Ala Met Ser Ser Leu Ser Asp Gly Lys Val
                220             225             230

tcc atc tca gca ggg att agt aag gct ctt gag gct atg gga gta cca        772
Ser Ile Ser Ala Gly Ile Ser Lys Ala Leu Glu Ala Met Gly Val Pro
            235             240             245

gca gaa aca gca caa tgg att gca ttt ggt ata cag tta gca atg att        820
Ala Glu Thr Ala Gln Trp Ile Ala Phe Gly Ile Gln Leu Ala Met Ile
            250             255             260

gca gtg act ata gct att ggt ttt gcc tct ggt ggt ggt gga gca atg        868
Ala Val Thr Ile Ala Ile Gly Phe Ala Ser Gly Gly Gly Gly Ala Met
    265             270             275

gct gga gtg tca aaa ata gca gat atg ttt tca aag tct caa gat gta        916
Ala Gly Val Ser Lys Ile Ala Asp Met Phe Ser Lys Ser Gln Asp Val
280             285             290             295

gct aag ttg gca cag atg att gaa aaa gct tct aaa ata gta caa atc        964
Ala Lys Leu Ala Gln Met Ile Glu Lys Ala Ser Lys Ile Val Gln Ile
            300             305             310

gct ggt tca gtt aat cag tct gct ata ggc ggt aca ggt att ggt aca       1012
Ala Gly Ser Val Asn Gln Ser Ala Ile Gly Gly Thr Gly Ile Gly Thr
            315             320             325

gct gta gtg caa agc aat ata aaa gct aat gaa tct gaa caa aaa gaa       1060
Ala Val Val Gln Ser Asn Ile Lys Ala Asn Glu Ser Glu Gln Lys Glu
            330             335             340

att gaa gct gct att gca aaa gtt aaa gct aag ata gag acg tta caa       1108
Ile Glu Ala Ala Ile Ala Lys Val Lys Ala Lys Ile Glu Thr Leu Gln
    345             350             355

gac ttc ttt aaa aac caa atg gaa caa ttc aat gct ata atg aaa ata       1156
Asp Phe Phe Lys Asn Gln Met Glu Gln Phe Asn Ala Ile Met Lys Ile
360             365             370             375

ata aca gat att att caa gat agc gtc aat aca aaa ata gct gtt caa       1204
Ile Thr Asp Ile Ile Gln Asp Ser Val Asn Thr Lys Ile Ala Val Gln
            380             385             390

cgt ggt gca cgt gag taa tacctttagt aaataacagtg actatactat            1252
Arg Gly Ala Arg Glu
            395

aatatataaa ttaataa                                                    1269
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<210> 14
<211> 396
<212> PRT
<213> Lawsonia intracellularis

<400> 14

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Met Thr Asn Phe Gly Asp Ile Ser Gly Ser Ser Ala Arg Met Ser Ser
1               5               10              15
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Leu Met Thr Gly Thr Ser Gly Glu Glu GLy Leu Glu Glu Leu Glu Gly
        20              25                  30


Gly Val Pro Lys Glu Gln Gly Gly Pro GLy Lys Gly Asp Ala Ser Glu
        35              40                  45


Ala Ala Lys Gly Gln Ala Ala Ala Asp Ser Ile Asn Ser Ala Gly Gly
    50              55                  60


Thr Glu Lys Pro Gly Glu Val Gly Asp Lys Glu Asp Val Gly Glu Gly
65              70              75                  80


Gly Glu Ile Pro Glu Gly Gly Glu Ile Pro Glu Gly Gly Glu Glu Val
                85              90                  95


Pro Glu Glu Pro Pro Tyr Val Pro Pro Pro Leu Val Glu Pro Ala Lys
            100             105             110


Ile Ser Thr Val Thr Asp Leu Ser Thr Leu Met Gly Ser Leu Gln Leu
        115             120             125


Thr Glu Gln Lys Lys Asn Ala Glu Lys Thr Val Asn Glu Ile Lys Ala
    130             135             140


Gln Asn Lys Glu Gln Gln Val Lys Phe Gln Glu Gln Ile Lys Lys Ile
145             150             155             160


Glu Asp Asn Ile Ala Glu Ser Lys Lys Ser Gly Ile Leu Lys Phe Phe
            165             170             175


Gln Lys Leu Phe Ala Val Ile Gly Ala Val Leu Gly Ala Ile Gly Gly
            180             185             190


Ala Leu Ala Ile Ala Ala Gly Ala Ala Ser Gly Asn Pro Leu Leu Val
        195             200             205


Ala Ala Gly Ile Met Ala Ile Val Ala Ser Ile Asp Ala Ala Met Ser
    210             215             220


Ser Leu Ser Asp Gly Lys Val Ser Ile Ser Ala Gly Ile Ser Lys Ala
225             230             235             240


Leu Glu Ala Met Gly Val Pro Ala Glu Thr Ala Gln Trp Ile Ala Phe
            245             250             255


Gly Ile Gln Leu Ala Met Ile Ala Val Thr Ile Ala Ile Gly Phe Ala
        260             265             270
```

```
Ser Gly Gly Gly Gly Ala Met Ala Gly Val Ser Lys Ile Ala Asp Met
        275             280             285

Phe Ser Lys Ser Gln Asp Val Ala Lys Leu Ala Gln Met Ile Glu Lys
    290             295             300

Ala Ser Lys Ile Val Gln Ile Ala Gly Ser Val Asn Gln Ser Ala Ile
305             310             315             320

Gly Gly Thr Gly Ile Gly Thr Ala Val Val Gln Ser Asn Ile Lys Ala
            325             330             335

Asn Glu Ser Glu Gln Lys Glu Ile Glu Ala Ala Ile Ala Lys Val Lys
            340             345             350

Ala Lys Ile Glu Thr Leu Gln Asp Phe Phe Lys Asn Gln Met Glu Gln
        355             360             365

Phe Asn Ala Ile Met Lys Ile Ile Thr Asp Ile Ile Gln Asp Ser Val
    370             375             380

Asn Thr Lys Ile Ala Val Gln Arg Gly Ala Arg Glu
385             390             395
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<210>  15
<211>  894
<212>  DNA
<213>  Lawsonia intracellularis


<220>
<221>  CDS
<222>  (13)..(894)

<400>  15
aggaggaatt at atg tct ctt gtc att aat aac aac ctg atg gcc gtc aat      51
              Met Ser Leu Val Ile Asn Asn Asn Leu Met Ala Val Asn
              1               5                   10

gct caa cgt aac tta agc aag tct tat gga gaa ctg agt tct tct gtt      99
Ala Gln Arg Asn Leu Ser Lys Ser Tyr Gly Glu Leu Ser Ser Ser Val
    15              20                  25

cga aaa ctt tct tca ggt ctt cgt gta gga act gct gct gat gac tca     147
Arg Lys Leu Ser Ser Gly Leu Arg Val Gly Thr Ala Ala Asp Asp Ser
30              35                  40                  45

gca ggg tta gcc att cga gaa ctc atg aga tct gac att gca aca aca     195
Ala Gly Leu Ala Ile Arg Glu Leu Met Arg Ser Asp Ile Ala Thr Thr
            50                  55                  60

caa caa gga ata cga aat gcg aat gat gct att tct atg att caa act     243
Gln Gln Gly Ile Arg Asn Ala Asn Asp Ala Ile Ser Met Ile Gln Thr
            65                  70                  75

gcg gat ggt gca ctt gga gtc atc gat gaa aag ctc att cga atg aaa     291
```

```
            Ala Asp Gly Ala Leu Gly Val Ile Asp Glu Lys Leu Ile Arg Met Lys
                    80                  85                  90

gaa ctt gct gaa caa gct gct aca ggt aca tat aac tcc act cag cgt        339
Glu Leu Ala Glu Gln Ala Ala Thr Gly Thr Tyr Asn Ser Thr Gln Arg
    95                 100                 105

atg att att gac tct gaa tat caa gct atg gcc tca gaa att act cgt        387
Met Ile Ile Asp Ser Glu Tyr Gln Ala Met Ala Ser Glu Ile Thr Arg
110                 115                 120                 125

att gct aat gcg aca gaa ttt aat ggt ata aaa ctt ctt gat ggt tca        435
Ile Ala Asn Ala Thr Glu Phe Asn Gly Ile Lys Leu Leu Asp Gly Ser
                130                 135                 140

tta tca ggt aat cat gat ggg aaa aaa ata aat tca act ggt gca gta        483
Leu Ser Gly Asn His Asp Gly Lys Lys Ile Asn Ser Thr Gly Ala Val
                145                 150                 155

cgt atc cac ttt ggg aca tct aac agc tct gct gaa gat tac tat gat        531
Arg Ile His Phe Gly Thr Ser Asn Ser Ser Ala Glu Asp Tyr Tyr Asp
                160                 165                 170

att aaa att ggt ggc tct aca gct tct gca tta gga ctt ggt aat aca        579
Ile Lys Ile Gly Gly Ser Thr Ala Ser Ala Leu Gly Leu Gly Asn Thr
    175                 180                 185

gta aaa ggt gcg ggt gct aca gtc tct act caa gct gca gca caa aat        627
Val Lys Gly Ala Gly Ala Thr Val Ser Thr Gln Ala Ala Ala Gln Asn
190                 195·                200                 205

gcc tta aaa gct ata gat aat gcc att gtt tca aaa gat aaa att cga        675
Ala Leu Lys Ala Ile Asp Asn Ala Ile Val Ser Lys Asp Lys Ile Arg
                210                 215                 220

gca cac ctt ggt gga tta caa aat aga ctt gaa gct aca gtt gat aat        723
Ala His Leu Gly Gly Leu Gln Asn Arg Leu Glu Ala Thr Val Asp Asn
                225                 230                 235

tta agt ata caa aat gaa aac tta caa gct gct gaa tct cgt ata tct        771
Leu Ser Ile Gln Asn Glu Asn Leu Gln Ala Ala Glu Ser Arg Ile Ser
                240                 245                 250

gat ata gat gta agc caa gaa atg aca caa ttt gta cgt aac caa ata        819
Asp Ile Asp Val Ser Gln Glu Met Thr Gln Phe Val Arg Asn Gln Ile
    255                 260                 265

ctt aca caa aca ggt gtt gct atg ctt tca caa gct aat tct cta cca        867
Leu Thr Gln Thr Gly Val Ala Met Leu Ser Gln Ala Asn Ser Leu Pro
270                 275                 280                 285

cgt atg gct cag caa ctt att ggc taa                                    894
Arg Met Ala Gln Gln Leu Ile Gly
                290
```

<210> 16
<211> 293
<212> PRT
<213> Lawsonia intracellularis

<400> 16

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Met Ser Leu Val Ile Asn Asn Asn Leu Met Ala Val Asn Ala Gln Arg
1               5                   10                  15
```

```
Asn Leu Ser Lys Ser Tyr Gly Glu Leu Ser Ser Ser Val Arg Lys Leu
         20              25              30

Ser Ser Gly Leu Arg Val Gly Thr Ala Ala Asp Asp Ser Ala Gly Leu
         35              40              45

Ala Ile Arg Glu Leu Met Arg Ser Asp Ile Ala Thr Thr Gln Gln Gly
     50              55              60

Ile Arg Asn Ala Asn Asp Ala Ile Ser Met Ile Gln Thr Ala Asp Gly
65              70              75              80

Ala Leu Gly Val Ile Asp Glu Lys Leu Ile Arg Met Lys Glu Leu Ala
             85              90              95

Glu Gln Ala Ala Thr Gly Thr Tyr Asn Ser Thr Gln Arg Met Ile Ile
         100             105             110

Asp Ser Glu Tyr Gln Ala Met Ala Ser Glu Ile Thr Arg Ile Ala Asn
         115             120             125

Ala Thr Glu Phe Asn Gly Ile Lys Leu Leu Asp Gly Ser Leu Ser Gly
     130             135             140

Asn His Asp Gly Lys Lys Ile Asn Ser Thr Gly Ala Val Arg Ile His
145             150             155             160

Phe Gly Thr Ser Asn Ser Ser Ala Glu Asp Tyr Tyr Asp Ile Lys Ile
             165             170             175

Gly Gly Ser Thr Ala Ser Ala Leu Gly Leu Gly Asn Thr Val Lys Gly
             180             185             190

Ala Gly Ala Thr Val Ser Thr Gln Ala Ala Ala Gln Asn Ala Leu Lys
         195             200             205

Ala Ile Asp Asn Ala Ile Val Ser Lys Asp Lys Ile Arg Ala His Leu
     210             215             220

Gly Gly Leu Gln Asn Arg Leu Glu Ala Thr Val Asp Asn Leu Ser Ile
225             230             235             240

Gln Asn Glu Asn Leu Gln Ala Ala Glu Ser Arg Ile Ser Asp Ile Asp
             245             250             255

Val Ser Gln Glu Met Thr Gln Phe Val Arg Asn Gln Ile Leu Thr Gln
         260             265             270
```

```
Thr Gly Val Ala Met Leu Ser Gln Ala Asn Ser Leu Pro Arg Met Ala
        275                 280                 285


Gln Gln Leu Ile Gly
     290


<210>   17
<211>   2848
<212>   DNA
<213>   Lawsonia intracellularis


<220>
<221>   CDS
<222>   (29)..(2848)

<400>   17                                              '
accttaacta aaaataaaa agaatatt atg tat aat ata att aat aag cat          52
                              Met Tyr Asn Ile Ile Asn Lys His
                              1               5


caa atc ata aaa att tta tta ttt tcc tta tgt gtt ttc ttt ttt aca       100
Gln Ile Ile Lys Ile Leu Leu Phe Ser Leu Cys Val Phe Phe Phe Thr
    10              15              20


ctt aca gaa aaa caa aaa att tat gct gca gac gtc ttt ttt gag ggc       148
Leu Thr Glu Lys Gln Lys Ile Tyr Ala Ala Asp Val Phe Phe Glu Gly
25              30              35                              40


aga acc gaa acc tta atc aat gta aac aaa cca ttt gat tct ttt ttt       196
Arg Thr Glu Thr Leu Ile Asn Val Asn Lys Pro Phe Asp Ser Phe Phe
                45              50              55


gga ggt tct gac tct aca ata gga acc ctt gaa aca gga cct act aat       244
Gly Gly Ser Asp Ser Thr Ile Gly Thr Leu Glu Thr Gly Pro Thr Asn
            60              65              70


ctt acc ttc aca aca gta gga gcc ttc cgc aat tct gtt ttc aga att       292
Leu Thr Phe Thr Thr Val Gly Ala Phe Arg Asn Ser Val Phe Arg Ile
            75              80              85


att ggt ggt ggt agg tct agt ttt aac aac cca aat aca gtt aaa ggc       340
Ile Gly Gly Gly Arg Ser Ser Phe Asn Asn Pro Asn Thr Val Lys Gly
    90              95              100


aat gtt act cta act gtt tat aat act gat gta gaa aga ata att ggt       388
Asn Val Thr Leu Thr Val Tyr Asn Thr Asp Val Glu Arg Ile Ile Gly
105             110             115             120


gca ggt atc agc aat aga gga ctt gta acc gtt act ggc tca gta aat       436
Ala Gly Ile Ser Asn Arg Gly Leu Val Thr Val Thr Gly Ser Val Asn
                125             130             135


atg aag cta gaa aat gtt tct gtt act aga gga att tat ggt ggt gtc       484
Met Lys Leu Glu Asn Val Ser Val Thr Arg Gly Ile Tyr Gly Gly Val
            140             145             150


tat act caa aat gga cat gta cta ggc tct atc aac atg cat ttg aaa       532
Tyr Thr Gln Asn Gly His Val Leu Gly Ser Ile Asn Met His Leu Lys
            155             160             165


aac gtc caa act cca cta tta ata ggt tct gga gta agc aat gga cct       580
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          Asn Val Gln Thr Pro Leu Leu Ile Gly Ser Gly Val Ser Asn Gly Pro
              170             175             180

aat cgt att act gta aat gga gac ata aac att gat gtt gaa gac tct        628
Asn Arg Ile Thr Val Asn Gly Asp Ile Asn Ile Asp Val Glu Asp Ser
185             190             195             200

agg att caa tat gta aac att aca gga gaa gta gat gca ggg ata aaa        676
Arg Ile Gln Tyr Val Asn Ile Thr Gly Glu Val Asp Ala Gly Ile Lys
                205             210             215

gga aat gct act cta act gta aaa aaa tct act gtt gag ctt ata aac        724
Gly Asn Ala Thr Leu Thr Val Lys Lys Ser Thr Val Glu Leu Ile Asn
            220             225             230

tct ggt aga ggt aat atc tta ggt aat ctc aaa ata tct ata gca gat       772
Ser Gly Arg Gly Asn Ile Leu Gly Asn Leu Lys Ile Ser Ile Ala Asp
            235             240             245

tca aat ata agg ggg tta tca cca gta gac ttt ggt tct tca gta tat       820
Ser Asn Ile Arg Gly Leu Ser Pro Val Asp Phe Gly Ser Ser Val Tyr
        250             255             260

ggg gac aca tct ata aat gta att aat tct cag att aat gat att act       868
Gly Asp Thr Ser Ile Asn Val Ile Asn Ser Gln Ile Asn Asp Ile Thr
265             270             275             280

ctt ata cca agg gct ggt gga atg ctt gta ggt cct gtt acc cta gat       916
Leu Ile Pro Arg Ala Gly Gly Met Leu Val Gly Pro Val Thr Leu Asp
                285             290             295

atc aca agc agt act ata caa aat ata caa tgt ggg cct gtc agt caa       964
Ile Thr Ser Ser Thr Ile Gln Asn Ile Gln Cys Gly Pro Val Ser Gln
            300             305             310

aat aat caa ctt aac aca cta aat gta act gtt aat act agt aac att       1012
Asn Asn Gln Leu Asn Thr Leu Asn Val Thr Val Asn Thr Ser Asn Ile
        315             320         .. 325

act aac tta aac ctt ggt agt gtc gaa ggt cat aca ata tca act aca       1060
Thr Asn Leu Asn Leu Gly Ser Val Glu Gly His Thr Ile Ser Thr Thr
        330             335             340

gca act gtt act gat agt aat att act aac ctt aat gtc gga acc ttc       1108
Ala Thr Val Thr Asp Ser Asn Ile Thr Asn Leu Asn Val Gly Thr Phe
345             350             355             360

aat gga ctt gga gta act gag aat gcc tct gta atc att aat agt ggc       1156
Asn Gly Leu Gly Val Thr Glu Asn Ala Ser Val Ile Ile Asn Ser Gly
                365             370             375

aat att act aac ctt aat gtc gga act aat gta ata gct gca gcc aca       1204
Asn Ile Thr Asn Leu Asn Val Gly Thr Asn Val Ile Ala Ala Ala Thr
            380             385             390

act att aat tcc tct gcg acc ata cac gac gga ctt att gca aac ctt       1252
Thr Ile Asn Ser Ser Ala Thr Ile His Asp Gly Leu Ile Ala Asn Leu
            395             400             405

acc tta ggc tca caa ggt aat ggt cgt act atg ata gct aca gca aat      1300
Thr Leu Gly Ser Gln Gly Asn Gly Arg Thr Met Ile Ala Thr Ala Asn
        410             415             420

gtt aat ggt gga act att gga tta tta act atg ggt tca gaa aac ttc       1348
Val Asn Gly Gly Thr Ile Gly Leu Leu Thr Met Gly Ser Glu Asn Phe
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       425                  430                  435                  440

ata cca ggc aca aga cca att act gaa tta gca ata cta aac atg tct        1396
Ile Pro Gly Thr Arg Pro Ile Thr Glu Leu Ala Ile Leu Asn Met Ser
                    445                  450                  455

ggt gga tta att gaa aga att atc gta ggt aat gcc aac tct tca acc        1444
Gly Gly Leu Ile Glu Arg Ile Ile Val Gly Asn Ala Asn Ser Ser Thr
                460                  465                  470

ata aac ttt act cct ggg aag aga tca att gta aaa aca ata aat ggt        1492
Ile Asn Phe Thr Pro Gly Lys Arg Ser Ile Val Lys Thr Ile Asn Gly
                475                  480                  485

cca gaa ctt cca tat tta gtt aac ata caa aaa ggt gct atg aca caa        1540
Pro Glu Leu Pro Tyr Leu Val Asn Ile Gln Lys Gly Ala Met Thr Gln
        490                  495                  500

tgg ggc act aaa aat atg ccc ttt tta ttg gat aca aga aat tta atc        1588
Trp Gly Thr Lys Asn Met Pro Phe Leu Leu Asp Thr Arg Asn Leu Ile
505                  510                  515                  520

ttg tcc gga act ctg att acc tca aat att caa cta gct gat tta tct        1636
Leu Ser Gly Thr Leu Ile Thr Ser Asn Ile Gln Leu Ala Asp Leu Ser
                525                  530                  535

ata acc aat cta ttt gtt gct aat ggc ggt aca cta gta cct aga aaa        1684
Ile Thr Asn Leu Phe Val Ala Asn Gly Gly Thr Leu Val Pro Arg Lys
                540                  545                  550

tta ata cct ggg aac caa cct gtt ata cag ttt ctt gga ggt cct caa        1732
Leu Ile Pro Gly Asn Gln Pro Val Ile Gln Phe Leu Gly Gly Pro Gln
                555                  560                  565

tca ctc tta gtt atc cat caa cca tta aaa gta aat tta agc tta tca        1780
Ser Leu Leu Val Ile His Gln Pro Leu Lys Val Asn Leu Ser Leu Ser
        570                  575                  580

cca aaa ctt att gga agt agc atg gtg cca ctt gct ttt gtc tct caa        1828
Pro Lys Leu Ile Gly Ser Ser Met Val Pro Leu Ala Phe Val Ser Gln
585                  590                  595                  600

tct ttt tca tca cca gat ctt ttt gtt aaa caa act aga agt ggt ctc        1876
Ser Phe Ser Ser Pro Asp Leu Phe Val Lys Gln Thr Arg Ser Gly Leu
                605                  610                  615

att tgg agt gat ctt gag ttt gat cca aca aca tct att tgg tat gtt        1924
Ile Trp Ser Asp Leu Glu Phe Asp Pro Thr Thr Ser Ile Trp Tyr Val
                620                  625                  630

aat aat atc caa gca tct caa gat ttt tac tct ttc tct att gct cgt        1972
Asn Asn Ile Gln Ala Ser Gln Asp Phe Tyr Ser Phe Ser Ile Ala Arg
                635                  640                  645

gag act act aac tgg cta aga caa caa cat ata tgg act cta caa aac        2020
Glu Thr Thr Asn Trp Leu Arg Gln Gln His Ile Trp Thr Leu Gln Asn
        650                  655                  660

cgt tca agt aaa ctt tta gac aac gaa cat tat gga cta tgg ata aat        2068
Arg Ser Ser Lys Leu Leu Asp Asn Glu His Tyr Gly Leu Trp Ile Asn
665                  670                  675                  680

gtt caa ggt gga cat gaa agt ctt gat act tct att ggt agc aaa gca        2116
Val Gln Gly Gly His Glu Ser Leu Asp Thr Ser Ile Gly Ser Lys Ala
                685                  690                  695
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aaa atg cca tgg ata atg gca aca gca gga tat gac tat ctt caa caa          2164
Lys Met Pro Trp Ile Met Ala Thr Ala Gly Tyr Asp Tyr Leu Gln Gln
            700             705                 710

cta cca agg tta gat atg aaa gcc ctt tat ggt ctt gct ttt ggt gct          2212
Leu Pro Arg Leu Asp Met Lys Ala Leu Tyr Gly Leu Ala Phe Gly Ala
            715             720                 725

tct aaa ggt aaa agt aaa tgg tct agc gtc aac tct aca aaa aat gat          2260
Ser Lys Gly Lys Ser Lys Trp Ser Ser Val Asn Ser Thr Lys Asn Asp
        730             735             740

gct gag cta ggt atg gtt agt ggt tat gta ggt ctt atc cat aac aaa          2308
Ala Glu Leu Gly Met Val Ser Gly Tyr Val Gly Leu Ile His Asn Lys
745             750             755                 760

act ggg ctc tat agt aca ttg acc tta caa ctt gcg tct agt aaa tta          2356
Thr Gly Leu Tyr Ser Thr Leu Thr Leu Gln Leu Ala Ser Ser Lys Leu
                765             770             775

cat act aat tct aca ggg ttc tat aga aat ttt aaa tgg aca gaa aca          2404
His Thr Asn Ser Thr Gly Phe Tyr Arg Asn Phe Lys Trp Thr Glu Thr
                780             785             790

act cca aca gaa gca ctt gaa ctt gga tgg aaa tac act ttc aac aac          2452
Thr Pro Thr Glu Ala Leu Glu Leu Gly Trp Lys Tyr Thr Phe Asn Asn
            795             800             805

ggt att aaa atg aat cct cgt gga caa ctt att ttt gaa caa aca tct          2500
Gly Ile Lys Met Asn Pro Arg Gly Gln Leu Ile Phe Glu Gln Thr Ser
        810             815             820

aaa cac cat ttt gat tta gga att caa aat gat aag gct ata tta gat          2548
Lys His His Phe Asp Leu Gly Ile Gln Asn Asp Lys Ala Ile Leu Asp
825             830             835             840

aaa agc cag tta ata aca agt tct ctt ggt att acc gtt gaa tat aag          2596
Lys Ser Gln Leu Ile Thr Ser Ser Leu Gly Ile Thr Val Glu Tyr Lys
                845             850             855

cta cca gtt acc aca cct att aat ctt tat gct ggt att gaa agg ata          2644
Leu Pro Val Thr Thr Pro Ile Asn Leu Tyr Ala Gly Ile Glu Arg Ile
                860             865             870

aaa ggt cag tct gga aac ttt gca att agt tcc cag agc ctt caa atg          2692
Lys Gly Gln Ser Gly Asn Phe Ala Ile Ser Ser Gln Ser Leu Gln Met
            875             880             885

aag ttc aag cat gac aat gat aca agt gta gtt aga gca aca ata ggt          2740
Lys Phe Lys His Asp Asn Asp Thr Ser Val Val Arg Ala Thr Ile Gly
        890             895             900

aca aat ata tta ttg gga gaa cat ttt aat att cac tgt gat ata ttt          2788
Thr Asn Ile Leu Leu Gly Glu His Phe Asn Ile His Cys Asp Ile Phe
905             910             915             920

gga gat aaa gga aat gat aaa ggc att ggt ggg caa gca gga ttt aca          2836
Gly Asp Lys Gly Asn Asp Lys Gly Ile Gly Gly Gln Ala Gly Phe Thr
            925             930             935

tac aaa ttt taa                                                          2848
Tyr Lys Phe
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<210>    18
<211>    939
<212>    PRT
<213>    Lawsonia intracellularis

<400>    18

Met Tyr Asn Ile Ile Asn Lys His Gln Ile Ile Lys Ile Leu Leu Phe
1               5                   10                  15


Ser Leu Cys Val Phe Phe Phe Thr Leu Thr Glu Lys Gln Lys Ile Tyr
            20                  25                  30


Ala Ala Asp Val Phe Phe Glu Gly Arg Thr Glu Thr Leu Ile Asn Val
            35                  40                  45


Asn Lys Pro Phe Asp Ser Phe Phe Gly Gly Ser Asp Ser Thr Ile Gly
        50                  55                  60


Thr Leu Glu Thr Gly Pro Thr Asn Leu Thr Phe Thr Thr Val Gly Ala
65                  70                  75                  80


Phe Arg Asn Ser Val Phe Arg Ile Ile Gly Gly Gly Arg Ser Ser Phe
                85                  90                  95


Asn Asn Pro Asn Thr Val Lys Gly Asn Val Thr Leu Thr Val Tyr Asn
                100                 105                 110


Thr Asp Val Glu Arg Ile Ile Gly Ala Gly Ile Ser Asn Arg Gly Leu
            115                 120                 125             .


Val Thr Val Thr Gly Ser Val Asn Met Lys Leu Glu Asn Val Ser Val
            130                 135                 140


Thr Arg Gly Ile Tyr Gly Gly Val Tyr Thr Gln Asn Gly His Val Leu
145                 150                 155                 160


Gly Ser Ile Asn Met His Leu Lys Asn Val Gln Thr Pro Leu Leu Ile
                165                 170                 175


Gly Ser Gly Val Ser Asn Gly Pro Asn Arg Ile Thr Val Asn Gly Asp
            180                 185                 190


Ile Asn Ile Asp Val Glu Asp Ser Arg Ile Gln Tyr Val Asn Ile Thr
            195                 200                 205


Gly Glu Val Asp Ala Gly Ile Lys Gly Asn Ala Thr Leu Thr Val Lys
        210                 215                 220


Lys Ser Thr Val Glu Leu Ile Asn Ser Gly Arg Gly Asn Ile Leu Gly
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      225                   230                   235                   240


      Asn Leu Lys Ile Ser Ile Ala Asp Ser Asn Ile Arg Gly Leu Ser Pro
                      245                   250                   255


      Val Asp Phe Gly Ser Ser Val Tyr Gly Asp Thr Ser Ile Asn Val Ile
                      260                   265                   270


      Asn Ser Gln Ile Asn Asp Ile Thr Leu Ile Pro Arg Ala Gly Gly Met
              275                   280                   285


      Leu Val Gly Pro Val Thr Leu Asp Ile Thr Ser Ser Thr Ile Gln Asn
          290                   295                   300


      Ile Gln Cys Gly Pro Val Ser Gln Asn Asn Gln Leu Asn Thr Leu Asn
      305                   310                   315                   320


      Val Thr Val Asn Thr Ser Asn Ile Thr Asn Leu Asn Leu Gly Ser Val
                      325                   330                   335


      Glu Gly His Thr Ile Ser Thr Thr Ala Thr Val Thr Asp Ser Asn Ile
                      340                   345                   350


      Thr Asn Leu Asn Val Gly Thr Phe Asn Gly Leu Gly Val Thr Glu Asn
              355                   360                   365


      Ala Ser Val Ile Ile Asn Ser Gly Asn Ile Thr Asn Leu Asn Val Gly
          370                   375                   380


      Thr Asn Val Ile Ala Ala Ala Thr Thr Ile Asn Ser Ser Ala Thr Ile
      385                   390                   395                   400


      His Asp Gly Leu Ile Ala Asn Leu Thr Leu Gly Ser Gln Gly Asn Gly
                      405                   410                   415


      Arg Thr Met Ile Ala Thr Ala Asn Val Asn Gly Gly Thr Ile Gly Leu
                      420                   425                   430


      Leu Thr Met Gly Ser Glu Asn Phe Ile Pro Gly Thr Arg Pro Ile Thr
              435                   440                   445


      Glu Leu Ala Ile Leu Asn Met Ser Gly Gly Leu Ile Glu Arg Ile Ile
          450                   455                   460


      Val Gly Asn Ala Asn Ser Ser Thr Ile Asn Phe Thr Pro Gly Lys Arg
      465                   470                   475                   480


      Ser Ile Val Lys Thr Ile Asn Gly Pro Glu Leu Pro Tyr Leu Val Asn
                      485                   490                   495
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Ile Gln Lys Gly Ala Met Thr Gln Trp Gly Thr Lys Asn Met Pro Phe
        500                 505                 510


Leu Leu Asp Thr Arg Asn Leu Ile Leu Ser Gly Thr Leu Ile Thr Ser
        515                 520                 525


Asn Ile Gln Leu Ala Asp Leu Ser Ile Thr Asn Leu Phe Val Ala Asn
    530                 535                 540


Gly Gly Thr Leu Val Pro Arg Lys Leu Ile Pro Gly Asn Gln Pro Val
545                 550                 555                 560


Ile Gln Phe Leu Gly Gly Pro Gln Ser Leu Leu Val Ile His Gln Pro
            565                 570                 575


Leu Lys Val Asn Leu Ser Leu Ser Pro Lys Leu Ile Gly Ser Ser Met
        580                 585                 590


Val Pro Leu Ala Phe Val Ser Gln Ser Phe Ser Ser Pro Asp Leu Phe
        595                 600                 605


Val Lys Gln Thr Arg Ser Gly Leu Ile Trp Ser Asp Leu Glu Phe Asp
    610                 615                 620


Pro Thr Thr Ser Ile Trp Tyr Val Asn Asn Ile Gln Ala Ser Gln Asp
625                 630                 635                 640


Phe Tyr Ser Phe Ser Ile Ala Arg Glu Thr Thr Asn Trp Leu Arg Gln
            645                 650                 655


Gln His Ile Trp Thr Leu Gln Asn Arg Ser Ser Lys Leu Leu Asp Asn
        660                 665                 670


Glu His Tyr Gly Leu Trp Ile Asn Val Gln Gly Gly His Glu Ser Leu
        675                 680                 685


Asp Thr Ser Ile Gly Ser Lys Ala Lys Met Pro Trp Ile Met Ala Thr
    690                 695                 700


Ala Gly Tyr Asp Tyr Leu Gln Gln Leu Pro Arg Leu Asp Met Lys Ala
705                 710                 715                 720


Leu Tyr Gly Leu Ala Phe Gly Ala Ser Lys Gly Lys Ser Lys Trp Ser
            725                 730                 735


Ser Val Asn Ser Thr Lys Asn Asp Ala Glu Leu Gly Met Val Ser Gly
        740                 745                 750
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Tyr Val Gly Leu Ile His Asn Lys Thr Gly Leu Tyr Ser Thr Leu Thr
    755             760             765


Leu Gln Leu Ala Ser Ser Lys Leu His Thr Asn Ser Thr Gly Phe Tyr
    770             775             780


Arg Asn Phe Lys Trp Thr Glu Thr Thr Pro Thr Glu Ala Leu Glu Leu
785             790             795             800


Gly Trp Lys Tyr Thr Phe Asn Asn Gly Ile Lys Met Asn Pro Arg Gly
            805             810             815


Gln Leu Ile Phe Glu Gln Thr Ser Lys His His Phe Asp Leu Gly Ile
            820             825             830


Gln Asn Asp Lys Ala Ile Leu Asp Lys Ser Gln Leu Ile Thr Ser Ser
    835             840             845


Leu Gly Ile Thr Val Glu Tyr Lys Leu Pro Val Thr Thr Pro Ile Asn
    850             855             860


Leu Tyr Ala Gly Ile Glu Arg Ile Lys Gly Gln Ser Gly Asn Phe Ala
865             870             875             880


Ile Ser Ser Gln Ser Leu Gln Met Lys Phe Lys His Asp Asn Asp Thr
            885             890             895


Ser Val Val Arg Ala Thr Ile Gly Thr Asn Ile Leu Leu Gly Glu His
            900             905             910
    .

Phe Asn Ile His Cys Asp Ile Phe Gly Asp Lys Gly Asn Asp Lys Gly
    915             920             925


Ile Gly Gly Gln Ala Gly Phe Thr Tyr Lys Phe
    930             935
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